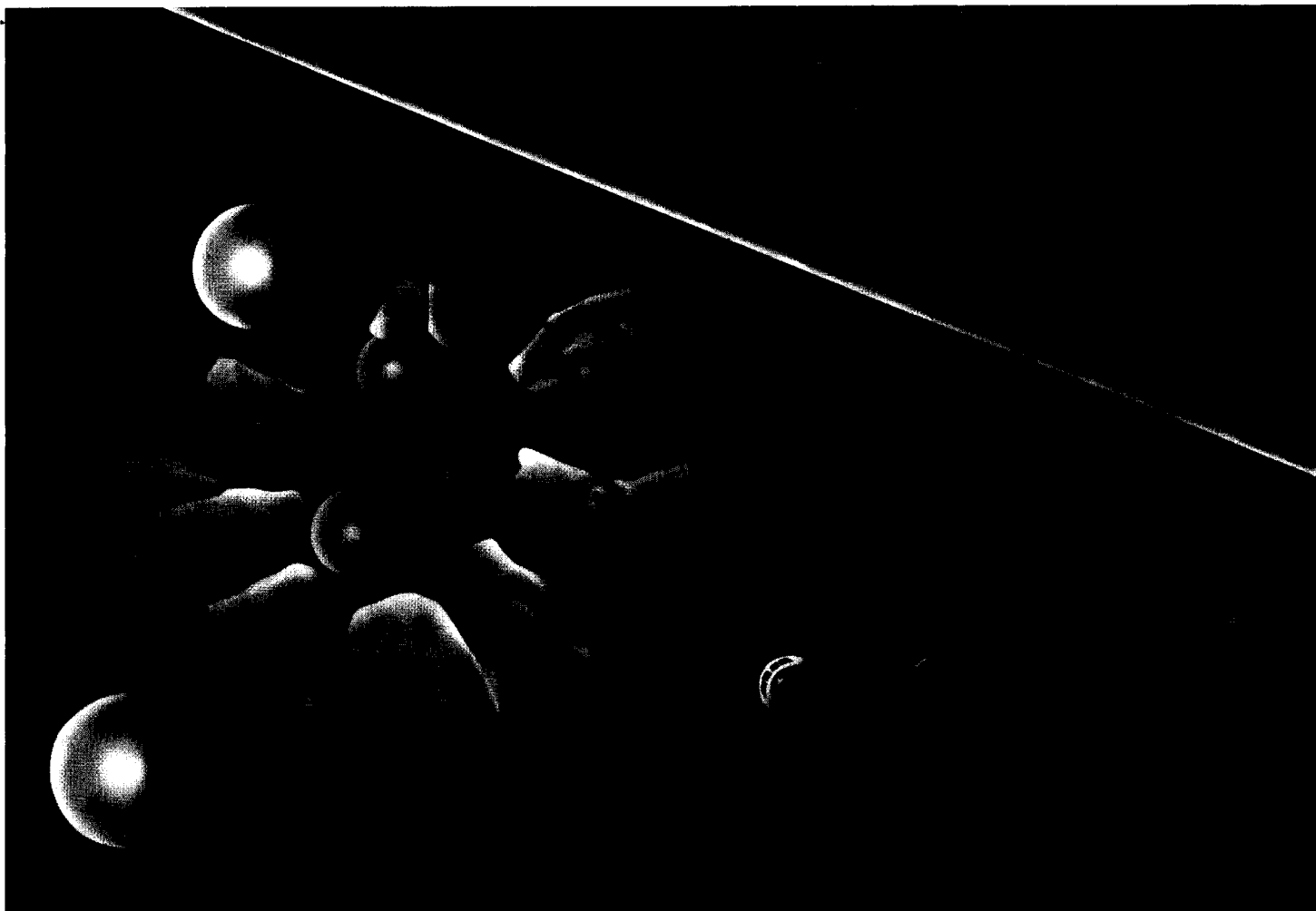


QUALITY AND PRODUCTIVITY IMPROVEMENT 1988 ACCOMPLISHMENTS REPORT



(NASA-TM-101848) NASA QUALITY AND
PRODUCTIVITY IMPROVEMENT PROGRAMS: 1988
ACCOMPLISHMENTS REPORT (NASA) 140 p

N90-70359

Unclas
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June 1989

NASA
National Aeronautics and
Space Administration

NASA QUALITY AND PRODUCTIVITY IMPROVEMENT PROGRAMS

1988 ACCOMPLISHMENTS REPORT

JUNE 1989

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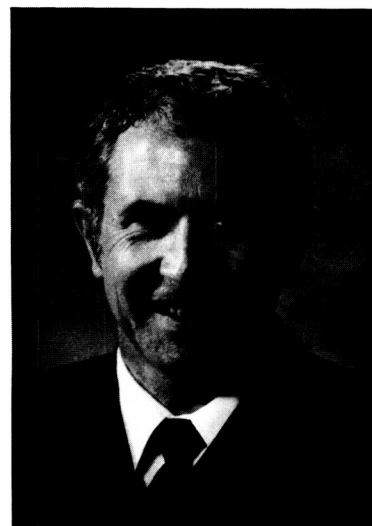
FOREWORD

The graceful arc of Discovery ascending to orbit signalled NASA's successful return to flight in 1988. This event was a tribute to the dedication and creativity of the NASA employees and contractors. We recognize that for NASA to successfully compete in the world market and maintain our leadership role in space, we must continue to improve the quality of our products and services as well as the productivity of our work force. Thus, NASA will continue to stress quality and productivity enhancement as a critical agency objective.

In the six years since the inception of the Accomplishments Report, NASA's vision of excellence has inspired many innovative approaches to NASA operations. This report highlights quality and productivity improvements achieved by NASA employees and contractors in 1988. These initiatives as well as others occurring throughout the agency are saving millions of dollars annually. I strongly endorse and support this commitment to excellence.

I commend the unswerving dedication and innovative efforts of the NASA employees and contractors.


Richard H. Truly
Acting Administrator



PREFACE

NASA employees and contractors are making great strides in quality and productivity improvement as evidenced by examples in this Accomplishments Report as well as our recent successful return to flight. These efforts are generating significant cost and time savings as well as promoting a strong team spirit. We must continue to work together to meet the quality and productivity challenges inherent in a successful, globally competitive space program.

The sixth annual Accomplishments Report highlights the initiatives that resulted in savings and improvements in 1988. Although we received more accomplishments than we were able to publish, *all* NASA quality and productivity initiatives are important because these efforts help us to work more efficiently and effectively to meet NASA's goals and mission as well as ongoing technical challenges and fiscal restraints.

This report includes a wide representation of NASA activities grouped in eight functional categories:

- Managerial Leadership
- Human Resources
- Improved Methods/Processes
- New Technology/Modernization
- Productivity Measurement
- Contractors - Contractor Effort
- Contractors - Joint Effort
- Contractors - Contract Administration

These accomplishments are presented as part of a continuing effort by NASA to share quality and productivity improvement ideas with the aerospace community and the public. A contact name and telephone number have been added to each entry. You are encouraged to use these contacts to obtain further details on any of the achievements contained in this report.

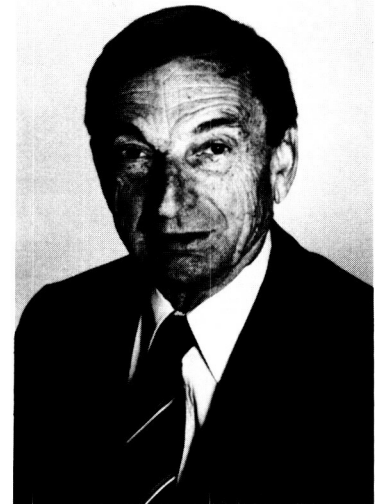


George A. Rodney
Associate Administrator for Safety, Reliability,
Maintainability and Quality Assurance



PREFACE

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A handwritten signature in cursive script, reading "George A. Rodney".

George A. Rodney
Associate Administrator for Safety, Reliability,
Maintainability and Quality Assurance

I. MANAGERIAL LEADERSHIP

1. Centerwide Automatic Data Processing Planning

Ames Research Center (ARC)

Description of the Activity:

During FY 1988, the center completed the first cycle of a new centerwide Automatic Data Processing (ADP) planning process. Management selected the ADP Planning Board, which consists of key ADP managers, to coordinate planning and budgeting for ADP. This is an important activity, comprising about 25 percent of the overall ARC budget.

The Board reviews the annual Information Technology Systems (ITS) Plan, which contains the ADP planning data required by the Office of Management and Budget as part of the annual budget exercise; and uses the ITS Plan to develop a strategic centerwide ADP Plan. Also, the Board evaluates near-term and long-range ADP acquisition plans. Major ADP acquisition plans that deviate from the centerwide ADP Plan are reviewed, and priorities are recommended for plans that exceed budget guidelines. The reviews and evaluations are guided by Board policies and approved by center management.

Benefits Achieved:

Prior to this new process, the center's plans for ADP were basically ad hoc (minimal or no coordination). The Board's policies are resulting in a more efficient and cost-effective ADP process that uses mass buy contracts and joint contracts by multiple center organizations. The centerwide Plan focuses ADP for center and Office of Astronautics and Space Technology (OAST) management in a coordinated, easy-to-review form. Since ADP is not segregated into a separate budget, center research managers retain the flexibility to trade off ADP and non-ADP expenses as their funds and priorities dictate.

Contact for more information:

B. Douglas Pearson, Jr.
408/464-6854

2. New Initiatives Office (NIO)

Johnson Space Center (JSC)

Description of the Activity:

The New Initiatives Office (NIO) was established in February 1988 to assist in directing and supporting the center's long-term strategic planning activities. Its primary roles are to provide: (1) centerwide focus for new project development; and (2) the initial interface with

NASA Headquarters, other agencies, and private industry to activate and develop new initiatives. The NIO structure and responsibilities include:

- Advanced Projects Definition Office - Initial definition and development of potential advanced projects and programs.
- Technology and Commercial Projects Office - Primary point of contact with outside organizations for technology and commercial projects, and the focal point within the center for managing technology development.
- Flight Projects Office - Interface between the STS and payload users and experiments; flight projects definition, development, and integration functions.
- Lunar and Mars Exploration Office - Development and evaluation of requirements and scenarios for the human exploration of space beyond low-earth orbit; and project management of the Mars Rover Sample Return Mission.
- Crew Emergency Return Vehicle Office - Project management of the CERV.
- Planning and Control Office - Overall strategic planning, procurement, budget management, and related activities.

Benefits Achieved:

The NIO supports the JSC strategy of managing new initiatives to optimize development of technologies and capabilities critical to NASA leadership in manned space exploration. Also, the NIO structure enhances relationships with external constituents so that JSC can effectively carry out its mission responsibilities.

Contact for more information:

Lyn Gordon-Winkler
713/282-1852

3. Team Excellence Program

Johnson Space Center (JSC)

Description of the Activity:

The JSC Team Excellence Program is an ongoing, centerwide effort to encourage both civil service and contractor employees from every level to recommend quality and productivity enhancements, and implement the approved actions. The Team Excellence Program has an overriding purpose: to provide a mechanism that will increase communication throughout the organizational hierarchy, to strengthen team-building and commitment to JSC goals. Individuals and organizations participate in team excellence

activities on a voluntary basis and in addition to their regular responsibilities. The major Team Excellence projects and accomplishments for 1988 include the following:

- **Flight Software Forum** - Resolved interface work issues through enhanced communications networking.
- **Safety, Reliability, and Quality Assurance** - Refined business practices and improved technical excellence through enhanced software assurance processes.
- **Engineering** - Increased understanding of issues and opportunities through identification of key issues.
- **Shuttle Mission Simulator Reconfiguration** - Improved workflow by identifying key work processes for implementing organizational changes and enhancements.
- **Propulsion and Power** - Tested a structured technology management process to prioritize projects and determine technological direction of the division to ascertain potential for centerwide application.
- **JSC/Contractor Forum** - Provided the JSC/contractor team members with an avenue for making recommendations to center management regarding technology, external relations, and strategic planning issues.

In addition, the first JSC Team Excellence Contractor awards were presented to Lockheed Engineering and Sciences Company, and the Rockwell Space Transportation Systems Division in December 1988. The award was established to recognize aerospace companies demonstrating outstanding dedication to quality and productivity in support of the U.S. manned spaceflight programs as JSC contractors and partners.

Benefits Achieved:

The intangible benefits achieved in striving to attain these goals include:

- Increased staff awareness and commitment to center goals resulting from their inclusion in the decision-making process.
- Enhanced understanding of the organization and the decision-making process, which promotes educated short- and long-term planning of activities.
- Clarification of individual roles and functions within that process.
- Increased levels of morale and team spirit among project participants resulting from the recognition of their contributions to center goals.
- Increased information flow up and down the system, leading to more effective formal channels of communication.

- Increased commitment from the JSC/contractor team to the center's strategic planning and team excellence efforts.

In acknowledgment of JSC effort, the center received two awards for its Team Excellence Program: (1) a Management Excellence Award presented in June 1988 by President Reagan's Council on Management Improvement, and (2) the 1988 Federal Executive Productivity Award presented by the Houston Federal Executive Board and Federal Business Association.

Contact for more information:

Wanda Thrower
713/483-4211

4. Langley Cost Savings Team - Presidential Management Improvement Award

Langley Research Center (LaRC)

Description of the Activity:

In the 1987 Accomplishments Report, it was noted that the Langley Cost Savings Team had received a Presidential Letter of Commendation. When the competition concluded in 1988, the Team was named as recipient of the Presidential Management Improvement Award. This achievement was honored by the presentation of the award by the Director of the Office of Management and Budget in a Washington, D.C., ceremony.

Benefits Achieved:

Constructive savings costs of approximately \$500,000 annually have been negotiated. During the past 5 years, the savings related to wages and fringe benefits have been estimated to exceed \$2 million.

Contact for more information:

Howard Puckett
804/864-6072

5. National Quality Forum

Langley Research Center (LaRC)

Description of the Activity:

In October 1988, Langley hosted the National Quality Forum in conjunction with the local

chapter of the American Society for Quality Control. The satellite program was broadcast from New York City where the Chief Executive Officers of major firms (such as IBM, Coca-Cola, and General Motors) shared their success stories relating to productivity and quality.

Benefits Achieved:

Attendance by center, contractor, and community leaders increased awareness of the level of commitment by these major corporations to productivity.

Contact for more information:

William L. Williams
804/864-1600

6. Productivity Steering Committee

Langley Research Center (LaRC)

Description of the Activity:

Langley has established a Productivity Steering Committee that is chaired by the Director for Management Operations. The other two Committee members are directorate heads. Serving in staff capacities are the head of the employee development committee, the productivity officer, and the quality circle facilitator.

Benefits Achieved:

The Committee provides a senior management focus on all aspects of the center productivity and quality enhancement activities.

Contact for more information:

Robert W. Feldhousen
804/864-7291

7. Lewis AWARENESS Program

Lewis Research Center (LeRC)

Description of the Activity:

The Lewis AWARENESS Program creates, develops, and leads internal programs that strengthen team pride, build employee commitment, and enhance communications. The Program resulted in 1,359 civil service and contractor employees being honored for

accomplishments through Team Recognitions and Team Promotions. Approximately 2,000 employees were recognized for their contributions through special functions and "Thank You" ceremonies. Approximately 6,500 invitations were sent to employees for various communications activities, such as: Issues and Answers (where the center Director answers anonymous questions from employees); Directorate Messages; Communications Follow-Ups; and "Let's Talk" programs covering specific topics at the center.

AWARENESS is a center Director program staffed by a program manager, secretary, and more than 60 volunteers from around the center. Many of the costs incurred by program activities are paid for through nonappropriated funds, at no additional cost to the taxpayer.

Benefits Achieved:

The AWARENESS Program enhances communications between center staff and senior management, builds employee dedication and pride in working together, promotes excellence, and encourages continued improvement. It further demonstrates top management support and concern for employee participation, teamwork, and outstanding performance.

Contact for more information:

Joyce Bergstrom
216/433-2940



During an AWARENESS Team Recognition Ceremony, Lewis Director Dr. John Klineberg congratulates Pamela Plencner of the Lewis Online Travel System Team. The Team developed an interactive business-oriented ADP application for travel at the center; the NASA Automated Information Management Council has recommended that this system be made available throughout the agency.

8. Lewis Selected as Quality Improvement Prototype

Lewis Research Center (LeRC)

Description of the Activity:

The Office of Management and Budget (OMB) has announced the selection of the Lewis Research Center as a Quality Improvement Prototype. Lewis was one of six facilities nationally to win this award, and is the only research and development organization ever to receive this honor.

The Quality Improvement Prototype Award is part of the President's Productivity Improvement Program administered by OMB. In announcing the selection, OMB Director Joseph Wright stated, "A prototype organization demonstrates an extraordinary commitment to quality improvement, focuses attention on satisfying its customers, and establishes high standards of quality, timeliness of government - showing how a commitment to quality leads to better and more efficient services and products for its customers."

Benefits Achieved:

Top management commitment to employee involvement and continuous quality improvement have been central to achieving the accomplishments cited by OMB as reasons for Lewis' selection. Some of the accomplishments include:

- A focus of team involvement and customer satisfaction as central priorities.
- Significant increases in invention disclosures and technical publications.
- Receipt of nearly 75 percent of the IR-100 Awards presented to NASA by R&D Magazine over the past 5 years for the most outstanding technical contributions.
- Receipt of the Collier Trophy (1987), awarded by the National Aeronautics Association for the most outstanding aeronautics or astronautics achievement.
- Numerous process enhancements that are resulting in improved quality and productivity.

Contact for more information:

David J. Steigman
216/433-2914

9. MSFC Strategic Plan and Guiding Principles

Marshall Space Flight Center (MSFC)

Description of the Activity:

A progress report on goals and objectives as contained in the MSFC Strategic Plan was distributed to all center employees in December 1988. The Strategic Plan Progress Report, "A Reflection on 1988 ...A View Toward 1989," also includes a set of guiding principles that were developed for the center in 1988. These principles (also distributed directly to employees) commit MSFC to the following:

- Overall excellence
- Recognition of the importance of its work force
- High ethical standards
- Equal opportunity for all personnel
- Open and effective communications
- A spirit of teamwork with our contractors
- High quality, safety, and reliability
- Cooperation within NASA and the aerospace community
- Aggressive pursuit of new challenges
- Maintenance of diversification in products and capabilities.

Benefits Achieved:

The MSFC Strategic Plan provides the framework for planning and implementing the center's assigned projects as well as influences its future. The progress report both reiterates those objectives and delineates overall progress toward them. The guiding principles capsule those ideals that drive us toward continuous improvement.

Contact for more information:

Charles Darwin
205/544-0450

or William Marshall (Guiding Principles Only)
205/544-0718

10. Incentive Awards

Marshall Space Flight Center (MSFC)

Description of the Activity:

Incentive award funds are a means for recognizing employee and group accomplishments. These funds, which have risen steadily since 1983, were increased by approximately 19 percent in 1988. Also, a nearly 11 percent increase has been budgeted for 1989.

Benefits Achieved:

In 1988, approximately \$900,000 of incentive award funds (including merit pay cash awards) were awarded to 1,734 employees for individual or group achievement. In addition, 1,504 civil service employees and 715 contractors were honored with NASA Headquarters honorary awards. Overall, the MSFC Awards Program effectively recognized 84 percent of its employees for contributions to center success in 1988.

Contact for more information:

Judy Arnold
205/544-7545

11. Virginia Productivity Center (VPC)

Marshall Space Flight Center (MSFC)

Description of the Activity:

In late 1987, MSFC awarded a study grant to the Virginia Productivity Center (VPC). The grant to VPC was structured in two phases. Phase I (complete) covered five steps: in December 1987 - (1) an initial design session, and (2) administration of the ASSESS instrument to a stratified random sample of MSFC managers; in January 1988 - (3) a series of roadblock identification sessions with a stratified random sample of managers and employees, and (4) a performance improvement workshop with the MSFC management team; and in July 1988 - (5) a productivity improvement workshop.

The primary purpose of the 2-day workshop was to identify objectives and develop a strategy for reaching these goals. The workshop included representatives of the NASA Quality and Productivity Improvement Programs Office; and six MSFC contractors (BAMSI, Boeing Aerospace, Boeing Computer Support Services, MSI, Morton Thiokol, and Rocketdyne).

Phase II (underway) has already included a mid-year review with the procurement process teams; a special review with the MSFC Productivity Steering Council; a closeout session

with the MSFC management team; and a strategic planning workshop with the Productivity Improvement Office, and selected MSFC prime and support services contractors.

Benefits Achieved:

The VPC process appears to be an excellent tool for strategic performance planning and overall team building. The experience of the MSFC Productivity Office, in using the VPC process and facilitating an adapted version with other MSFC organizations, has been very encouraging.

Contact for more information:

Sammy Nabors
205/544-5226



Pictured is Dr. Sink, VPC, and members of the MSFC Procurement Process Planning team during the mid-year review.

12. Commercial Programs Advisory Committee (CPAC)

NASA Headquarters (Code C)

Description of the Activity:

The Office of Commercial Programs has established the CPAC consisting of 18 Chief Executive Officers and University equivalents. Aerospace, non-aerospace, large, small, and financial organizations are all represented. The Committee reviews NASA policies and programs, and recommends strategies to implement national space policy goals.

Benefits Achieved:

By involving industry and academia in the decision-making processes, NASA gains invaluable partners with insight from a private industry perspective. With input from individuals of this caliber, NASA is more likely to gain consensus from national leaders as to the commercial direction of this country relative to space programs.

Contact for more information:

Dr. Barbara Stone
202/453-8720

13. High Temperature Superconductivity Working Group

NASA Headquarters (Code C)

Description of the Activity:

NASA has established a High Temperature Superconducting Working Group to coordinate ongoing NASA superconductivity research at NASA field installations, assess the impact of new superconducting material on aerospace technology and missions, and define and recommend to NASA its role in superconductivity research. The working group is also coordinating its activities with other major federal agencies.

Benefits Achieved:

Superconducting material can reduce potential application costs of certain technologies. This could result in achievements such as micro-miniaturization of components leading to more efficient systems. A coordinated approach to this promising field will shorten research time and reduce duplication of effort.

Contact for more information:

Henry Clarks
202/453-8722

14. Office of Commercial Programs Strategic Planning

NASA Headquarters (Code C)

Description of the Activity:

The Office of Commercial Programs is developing a comprehensive plan for commercial development of space primarily aimed at meeting the needs and interests of U.S. industry over the next 25 years. NASA has asked the American Institute of Aeronautics and Astronautics to help identify issues and recommend objectives to consider. The final product will serve as a baseline for NASA strategic and tactical planning that will allow for the evolution of new needs and technologies. It will be a public document that explains and illustrates the basis of planning for the development of commercial space-related products and services.

Benefits Achieved:

Involving an outside organization with private sector members in planning activities will assist NASA in addressing the needs and interests of U.S. industry. The report will provide an invaluable resource in planning for space-related product development.

Contact for more information:

Dr. Barbara Stone
202/453-8720

15. Occupational Health Communications - Education

NASA Headquarters (Code NPG)

Description of the Activity:

Communications in the NASA Occupational Health community have been enhanced considerably. A quarterly Occupational Health Newsletter with center inputs is prepared and distributed. An Annual Occupational Health Conference is held with support from well-recognized health experts. (The Surgeon General gave the keynote address this year.) NASA has held special training/updating sessions on occupational health nursing, workers' compensation, employee assistance programs, and physical fitness. Awards are presented for outstanding achievements/contributions. The proceedings are printed and distributed.

Also, pamphlets on health stabilization and hypertension were prepared and distributed. Medical Review Officers were trained, asbestos and respiratory protection courses were provided, and hazard communication training materials were obtained and distributed.

Benefits Achieved:

NASA Occupational Health personnel and others are better able to help conserve the health of employees by frequent and varied communication/educational efforts, designed to keep them informed of "state of the art" developments in the health area. They are able to learn and profit from the ongoing activities and accomplishments at other NASA sites. These efforts should prove to be economical approaches for enhancing and conserving the health of NASA employees.

Contact for more information:

Dr. Levine Marshal
202/755-1275

16. Fifth Annual NASA Contractors Conference on Quality and Productivity

NASA Headquarters (Code Q)

Description of the Activity:

The Fifth Annual NASA/Contractors Conference on Quality and Productivity, sponsored by NASA's Quality and Productivity Improvement Programs Office and hosted by the Lewis Research Center, took place in October 1988. Over 40 government and industry executives gave presentations on various aspects of the conference theme: "Quality - A Commitment to the Future." In addition, an update on the contract incentives issue that had been raised at the Fourth Annual NASA/Contractors Conference was provided by members of the NASA committee investigating the potential for expanding contract incentives.

Benefits Achieved:

The annual NASA/Contractors Conferences provide a medium through which NASA and Contractors can exchange information, ideas, and concerns about quality and productivity. Positive feedback was provided by the group investigating contract incentives, and the attendees were able to witness the results of ideas that were provided by NASA and contractors at last year's event. In addition, the attendees participated in the announcement of the recipient of the 1987-88 NASA Excellence Award for Quality and Productivity, which added an air of suspense to the conference.

Contact for more information:

Geoffrey B. Templeton
202/453-8415

17. NASA Quality Month Activities

NASA Headquarters (Code Q)

Description of the Activity:

The NASA Quality and Productivity Improvement Programs Office initiated the action for a proclamation signed by the Administrator designating October 25, 1988, as NASA Quality Day. Associated with this proclamation were a variety of activities sponsored by Code QB, including the distribution of posters and pins with the theme: "Quality - A Commitment to the Future," and a one-day seminar at NASA Headquarters on October 25. The seminar featured presentations by key NASA officials; the NASA Employee Team (NET) Coordinators; and Rocketdyne, the recipient of the 1987-88 NASA Excellence Award for Quality and Productivity.

Benefits Achieved:

The most important benefit of the Quality Month activities was an agencywide awareness and recognition of the importance of quality to NASA's mission. The proclamation signed by the Administrator (a "first" for NASA), and the distribution of posters and pins, served to thank NASA employees for their efforts and to encourage further improvements in quality and productivity. The seminar on NASA Quality Day was broadcast to the centers via NASA Select, enabling NASA employees to observe what is being done throughout the agency to make quality and productivity improvement a top priority at NASA.

Contact for more information:

Geoffrey B. Templeton
202/453-8415

18. NASA Excellence Award for Quality and Productivity

NASA Headquarters (Code Q)

Description of the Activity:

During 1988, NASA selected the third recipient of the NASA Excellence Award for Quality and Productivity - the Rocketdyne Division of Rockwell International Corporation. In addition, the NASA Excellence Award process was evaluated and modified to include Small Business, further clarify the criteria, and standardize the evaluation process.

Benefits Achieved:

The NASA Excellence Award for Quality and Productivity recognizes excellence in the contractor community. The learning process that takes place when a company applies for the award is beneficial for the company (and for the NASA evaluators) since it affords an

opportunity to review techniques and methodologies for improving the quality and productivity.

Contact for more information:

Anthony T. Diamond
202/453-8415

19. Agencywide Information System Life-Cycle and Documentation Standards

NASA Headquarters (Code Q)

Description of the Activity:

The Software Management and Assurance Program (SMAP) has issued an agencywide set of Information System Life-Cycle and Documentation Standards. The five-volume set provides a consistent NASA-wide approach to a tailorable life-cycle process, and the structure and formats for documenting the products of that process. The standards are essential to managing and assuring the information system development process. The standards identify the critical products and activities required for software product assurance, and define the development life-cycle. The standards also detail the software management plans, assurance and engineering specifications, and reports and controls that must be documented in each phase.

Benefits Achieved:

The agencywide Information Life-Cycle and Documentation Standard facilitates the management and assurance of large, complex NASA-wide projects by providing a well-defined and uniform life-cycle and documentation structure. Thus, NASA no longer needs to generate and support multiple documentation standards at the centers. Since documentation is the most expensive element of software development and the principle source of errors, agency-level standardization should prove very beneficial to NASA.

Contact for more information:

Carl H. Schneider
202/453-2633

20. External Agreements

NASA Headquarters (Code S)

Description of the Activity:

In 1988, an Intergovernmental Agreement (IGA) and Memoranda of Understanding (MOUs) were negotiated to establish a cooperative effort on the detailed design, development, operation, and utilization of the permanently manned civil space station. An IGA was negotiated between the United States and our international partners (Belgium, Canada, Denmark, France, West Germany, Italy, Japan, the Netherlands, Norway, Spain, and the United Kingdom). The MOUs were negotiated between NASA and the international partner agencies (Ministry of State for Science and Technology of Canada, European Space Agency, and Government of Japan). The IGA and two of the three MOUs were formally signed at a State Department ceremony in September 1988.

Benefits Achieved:

These agreements implement the Presidential directive to seek the participation of our friends and allies in the Space Station Freedom (SSF) Program. The SSF is the largest international science and technology venture ever undertaken on a cooperative basis. Our partners are contributing approximately \$8 billion to the program, and bringing valuable hardware that will enhance user capabilities and be used in SSF assembly, maintenance, and servicing. Cooperation on the SSF venture will demonstrate Free World leadership and will serve to strengthen the ties among the partners.

Contact for more information:

Lyn Wigbels
202/453-8662

II. HUMAN RESOURCES

21. The "Peer Award" Program

Ames Research Center (ARC)

Description of the Activity:

As part of the ongoing effort to enhance excellence, the Acquisition Division has developed a "Peer Award" to be given to outstanding non-supervisory employees in recognition of their achievements and contributions toward NASA goals. The award committee (composed of non-supervisory employee volunteers) has developed the bylaws and criteria used for the selection process. This award is not intended as a replacement or substitute for a sustained performance award or any other awards that are presented by management. All levels of employees compete with each other based on the merit of the nomination and their contributions, rather than on a professional level or educational basis.

The committee performs the actual selection from the nominations received and presents the Peer Award at a yearly recognition award ceremony. In addition to a cash award, the recipients are given a certificate and a photo of themselves receiving the award. The names of the recipients are inscribed on a permanent plaque placed on the division's bulletin board and their pictures are displayed next to the plaque for 1 year.

Benefits Achieved:

Acknowledgment of an employee's achievement, hard work, and dedication can be especially gratifying when the recognition/award is made by peers. The Peer Award certainly enhanced the morale of everyone in the Acquisition Division because all had a voice in the nomination and selection of the recipients.

Contact for more information:

Jana M. Coleman
408/464-5820

22. The Center Professional Development Program: "A New Work Assignment At Ames Research Center"

Ames Research Center (ARC)

Description of the Activity:

The center Professional Development Program (PDP) is designed to give employees an opportunity for a new 3- to 6-month work assignment at ARC. The program was established to provide experimental learning in new tasks and functions by allowing

employees to broaden their background and gain experience in more than one discipline or career field. The program allows both administrative and technical employees to develop their managerial competencies or concentrate on gaining new experiences within current career fields.

The Professional Development Program has been actively utilized in several Directorates: Administration, Space Research, Aerospace Systems; and in the Office of the Comptroller.

Benefits Achieved:

The center PDP is an excellent way of utilizing human resources. It provides benefits to both the center and the participants. Participants are provided with an improved understanding of center policies, values, problems, and procedures. Assignments that are challenging to the participants and rewarding to the organizations help to make the program a success.

Contact for more information:

Meredith Moore
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23. Human Resource Communications

Goddard Space Flight Center (GSFC)

Description of the Activity:

In 1988, the Office of Human Resources' new quarterly newsletter, the Personnel Digest, was published. The Digest identifies center human resource programs and services, explains what they are, why they work as they do, and how to utilize them. One section, Human Resource Facts, provides data on the center's work force.

Four Human Resource Bulletins, which are short publications that detail particular services, were also published. These include: Competitive Placement Plan, Federal Hiring Procedures, Organizational Development and Consulting Services, and Career Management.

The New Employee Handbook, the first of a number of planned handbooks, was developed; and is distributed to new employees the day they report to duty.

Benefits Achieved:

With over 3,600 employees, effective communications are a central challenge to the center's management and the conduct of its various human resource programs. The Personnel Digest, Human Resource Bulletins, and the New Employee Handbook (and other handbooks being developed) enable program content, changes, and new initiatives to be communicated to the diverse employee audiences. These documents and communiques

provide the option of using in-depth information (e.g., handbooks) or brief overviews (e.g., articles in the Personnel Digest). Collectively, they provide a means of disseminating information and dealing directly with issues and myths that inevitably surround employment issues and systems.

Contact for more information:

Wayne H. Boswell
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24. Skills and Experience Inventory

Jet Propulsion Laboratory (JPL)

Description of the Activity:

A JPL Enhancement Team (JET) created a hard-copy and computer data base of its Section's personnel skills, knowledge, and experience. The hard-copy version contains photos of the personnel, an acronym list, and two types of listings: one by employee, including the skill and knowledge specialties of each; and the other by skills, including names of individuals who have expertise in specific areas.

Benefits Achieved:

The inventory is useful in introducing new employees to personnel resources within the Section. Also, it has reduced duplication of work efforts, thereby lowering the overall frustration level. The Section as a whole has benefited from the inventory; expediting location of appropriate personnel for specific tasks has resulted in improved product excellence and scheduling and reduced cost. Use of the inventory also assists supervisors in matching personnel with assignments.

Contact for more information:

John Wellman
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25. Establishment of Directorate-Level Human Resources Team

Johnson Space Center (JSC)

Description of the Activity:

A Human Resources Team (HRT) was organized by the JSC Operations Directorate, consisting of individuals that represent each of its seven divisions. The primary focus of the HRT is to provide a direct communication link between employees and upper management

to facilitate, clarify, and better understand the individual's role within the mission of the directorate.

Benefits Achieved:

The HRT identifies employee concerns in two areas: (1) single or one-time incidents that can be readily investigated, resolved, and closed; and (2) systemic concerns that can be resolved through an ongoing process between management and staff. The long-term issues currently being explored include improved communications, team building, and career development. Collectively, the joint identification of employee concerns, resolution of one-time incidents, and focus of management attention on the systemic areas for improvement, have promoted more positive and productive employee attitudes toward daily work responsibilities.

In addition, HRT has been an effective "mouthpiece" to management in identifying and resolving personnel concerns on a timely basis *before* they become more pronounced and difficult to resolve.

Contact for more information:

Earl Rubenstein
713/483-4807

26. Expanded Organizational Development Initiatives

Johnson Space Center (JSC)

Description of the Activity:

JSC's Human Resources Office has established a strategy to improve the overall effectiveness of center organizations by developing clear statements of goals and necessary actions for each organizational unit. A combination of employee surveys, survey analysis and assessment, and goal-setting/planning workshops serves as the basis for identifying and directing the planning agenda. Human Resources then guides the organization through a step-by-step process of selecting the priority (key) issues to be explored, gathering additional insights into the data through the use of focus groups, and developing action plans to address these issues. Since its inception in July 1987, the program has conducted approximately 45 goal-setting and planning workshops (of 1-2 days duration) for various center organizations, and has assessed employee concerns through interview and survey techniques for four to six organizations annually.

Benefits Achieved:

Organizations have found that this strategy also facilitates:

- A more informed planning mechanism based on valid information and feedback rather than ungrounded assumptions.
- Strengthened employee commitment resulting from inclusion into the decision-making process.
- Increased levels of communication between management and employees through activities encouraging teamwork.
- Improved likelihood of achieving organizational goals through joint commitment by management and employees.

Contact for more information:

John R. Duncan
713/483-1999

27. Reorganization for More Efficient Use of White Sands Test Facility

Johnson Space Center (JSC)

Description of the Activity:

Two sections in the White Sands Test Facility laboratories provide calibration and component refurbishment services to site customers. In the past, each section had performed their own scheduling. Customers requiring support had to interface with up to four people in different areas of the laboratories to obtain required services. In addition, estimated completion dates were not always reliable, which at times impacted test schedules. In 1988, a Support Services Group was formed to provide a single-point interface for all calibration and component refurbishment services. This group provides a central location for delivery and pick up of items, and manages an integrated workload scheduling system to provide more reliable completion date estimates.

Benefits Achieved:

The Support Services Group saves approximately 1.5 man-years annually for scheduling and approximately 1 man-year of customer time that was previously spent delivering and picking up items in several areas. This equates to approximately \$120,000 in savings each year. Of equal or greater significance are the intangible benefits obtained in providing customers with immediate status of items in the laboratories and reliable completion dates on services performed; and the improved efficiency in responding to customer requirements.

Contact for more information:

David L. Pippen
505/524-5722

28. STS Preemployment Examination Program

Kennedy Space Center (KSC)

Description of the Activity:

The NASA-KSC Space Transportation System (STS) Preemployment Examination Program was established as a management tool for determining the technical skill and knowledge level of entry-level employees. Since the inception of the program, several hundred applicants for positions as technicians and inspectors have taken the examination; approximately 60 percent achieved passing scores. Applicants who have achieved the FAA Airframe/Powerplant License within the last 5 years are exempt from the examination.

The preemployment testing program was initiated by a NASA-Contractor team that first conducted a feasibility study including a survey of the interest of the other NASA centers in having a NASA-wide Preemployment Testing Program. Responses were encouraging; however, other centers also stated an interest in KSC's developmental and implementation effort. Further study on a NASA-wide program is pending.

Program requirements were broadened (effective January 1989) to stipulate that any incumbent employees seeking transfers into technician/inspector positions must also satisfactorily pass the examination. Also, employees (both incumbent and new hires) assigned to work on the Thermal Protection System must satisfactorily pass the examination.

Benefits Achieved:

The preemployment testing program has led to an upgrade of technicians and inspectors currently working on flight and other critical systems. The new hires learn quickly and take on responsible roles after a very short period of time. Since these employees are more easily trained, there is a reduction in the training time with accompanying savings in training costs. The Preemployment Testing Program is playing a major role in assuring that KSC has a skilled work force that is unsurpassed by any work force in any field.

Contact for more information:

Dr. Marvin C. Williams
407/867-2491

29. Career Program Development

Lewis Research Center (LeRC)

Description of the Activity:

A new Lewis career development workshop allows participants to assess their interests, values, aptitudes, and needs to formulate a career plan. The workshop is offered over 3-1/2 days and is supported by ongoing one-on-one career counseling, software in the Learning Center, and standardized testing by a licensed practitioner.

A 4-hour Career Guidance Seminar was initiated in 1988 for supervisors and managers. The program provides hands-on skills in conducting a career guidance discussion with an employee. The discussion is a structured process for advising employees how they can grow and excel within their chosen career field.

The Career Expectations Workshop, also initiated in 1988, addresses expectations of employees who have been in a new job for about 1 year. It seeks to resolve unmet or unrealistic job and career expectations by providing factual information about the center's culture, individual career and job performance goals, and organizational goals.

Benefits Achieved:

As a result of these programs: (1) employees have a better understanding of career goals, which leads to greater job satisfaction and productivity; (2) present job expectations and performance factors are clarified; (3) employee career plans dovetail with the center's goals and objectives; and (4) employees learn that they can manage their own careers.

Contact for more information:

Joseph Wasdovich
216/433-2989

30. Lewis Pilot Program to Improve Performance Appraisals

Lewis Research Center (LeRC)

Description of the Activity:

Lewis has completed the first phase of a pilot effort to improve the performance appraisal system within Office of Personnel Management (OPM) and NASA regulations, and has begun implementation of phase two. Phase one involved experiments in two divisions with employees "rating their boss," providing feedback to supervisors on performance. Also, phase one included a Productivity Improvement and Quality Enhancement (PIQE) Task Team assigned to develop and recommend ways to make the performance appraisal more effective and meaningful for both supervisors and employees.

Phase two involves three divisions that are implementing both employee feedback and the Team's recommendations on a 1-year pilot program. Features of the new system (in addition to employee feedback) include: "People Elements" as well as "Task Elements," increased emphasis on employee development and continuous quality improvement, definition of what is required to "exceed" in certain categories, and administrative improvements. The pilot program has been presented to both NASA Headquarters and OPM personnel.

Benefits Achieved:

The division that piloted employee feedback in phase one achieved improvements in employee rating scores for supervisors of up to 1.5 standard deviations in some areas over a 10-month span. In phase two, this system will be expanded to two other divisions to see if similar results are obtained. After phase two is completed, employees and supervisors will be asked to evaluate the extent to which these improvements occurred. A decision on terminating, continuing, or institutionalizing the new system will be made at that time.

Contact for more information:

David J. Steigman
216/433-2914

31. Secretarial Development

Lewis Research Center (LeRC)

Description of the Activity:

As a result of the participative environment at Lewis, secretaries have more understanding of how to become more involved, and are encouraged by management to become an active part of the organization. Lewis recognizes that secretaries are a critical resource, and offers several center-developed programs. One of the programs, Building Excellence through Secretarial Teamwork, is a 3-day program designed to improve teamwork, professionalism, morale, and motivation of the secretarial staff.

The Certified Professional Secretary Program (CPS) supports study for achieving the CPS rating through on-site college courses in preparation for the CPS exam. A CPS Project Team, organized at the center, is chartered to promote secretaries as professionals.

The Essential Connection Quality Circle, composed of secretaries from throughout the center, has enhanced the positive image of the secretarial staff by implementing a program to recognize Professional Secretaries Week, the annual Lewis Secretarial Awards Program, and a more efficient process for distribution of correspondence at the center.

The Senior Secretarial Staff is a team that meets each month to exchange and update information with other centers and all Lewis secretaries.

Benefits Achieved:

As a result of these initiatives, the secretarial staff has been able to develop and enhance both their secretarial and leadership skills. A network has been developed to enable Lewis secretaries can share their experience and knowledge with other NASA centers and the local business community. Also, secretaries are able to make a stronger contribution to the goals and objectives of the center.

Contact for more information:

Mary Kovach
216/433-2994

32. NASA/MSFC Employee Teams

Marshall Space Flight Center (MSFC)

Description of the Activity:

The NASA Employee Team (NET) process at MSFC has 25 active and 9 inactive teams. The second annual NET Recognition/Exhibition/Awards were again hosted by the center Director, J.R. Thompson, in June 1988. The Director stressed the importance of team play and reiterated that the NET process embodies the "real spirit of Marshall Space Flight Center - the real right stuff." He also said that, "There is not another task more important at Marshall than being involved with the NET process. Each employee (both supervisory and non-supervisory personnel) must take the challenge to become involved in the improvement of productivity at the Marshall Space Flight Center." The importance of the NET process was reinforced by the following annual awards:

Center Director's NET Champion Award - Presented to the supervisor/manager who actively supports the MSFC NET process. The first such award was given to William R. Reynolds, Director of the center's Productivity Improvement Office.

Douglas F. Sandridge NET Leadership Award - Presented to the NET Leader who best exemplifies the participative process. This award went to Rosa M. Kilpatrick of the Institutional Program Support Directorate, who is the leader of the Fundseekers (a team composed of program analysts).

Center Director's Annual NET Award of Excellence - Presented to the NET that has most contributed to overall productivity improvement at MSFC. The first award was presented to the AQUANET - a team of voluntary safety divers from various MSFC organizations who support the Neutral Buoyancy Simulator operation. Two other

teams were finalists: the NETWORK of the Structures and Dynamics Laboratory and the Space NET of the Payload Projects Office.

Also, Group Achievement Awards were presented to several teams for achieving significant cost savings. Five part-time facilitators also received a group achievement award for their support and dedication to the NET process. Mr. Larry Miller of L. M. Miller and Company of Atlanta, Georgia, a recognized expert in the productivity field was the keynote speaker.

Benefits Achieved:

The NET program gives employees an opportunity to contribute to the improvement of products and processes at the center. Since its inception, NETs at MSFC have completed projects representing savings of approximately \$450,000 per year.

Contact for more information:

Carolyn McMillan
205/544-9523

33. Time Management Courses

Marshall Space Flight Center (MSFC)

Description of the Activity:

MSFC continues to offer Time Power and Time Systems courses. Both courses provide a systematic approach to effective time management. More than 650 MSFC employees (20 percent of the work force) have been exposed to time management training. (Approximately 500 were trained in 1988). It is anticipated that 250 to 350 additional MSFC employees will be trained in 1989. Based on MSFC's experience with the course, Goddard and Ames are testing the Time Systems workshop at their centers.

Benefits Achieved:

Participants report marked improvement in their effectiveness and efficiency. These results agree with more general studies that report productivity improvements of 25 to 30 percent when systematic time management is used.

Contact for more information:

Sammy Nabors
205/544-5226

34. Supervisory Development Program (SDP)

Marshall Space Flight Center (MSFC)

Description of the Activity:

MSFC has introduced a new Supervisory Developmental Program (SDP) for its mid-level supervisors and managers. The recently developed 3-day program will accommodate 30 participants. It features key center managers as presenters along with a 1-day session on performance excellence and stress management by Dr. John Adams, a recognized authority in the field. Dr. Adams holds a Ph.D. in organizational behavior from Case Western Reserve University. The first program was conducted in September 1988, at the University of Alabama, Huntsville campus.

Benefits Achieved:

The new SDP fills a void between MSFC's existing Basic Supervisory Orientation and its one-week residential Management Development Program (MDP). It provides the center with a systematic approach to fulfilling the training and development needs of its supervisory/management personnel.

Contact for more information:

Sylvia Thomas
205/544-7547

35. Mission Independent Training Program (MITP)

Marshall Space Flight Center (MSFC)

Description of the Activity:

The Payload Operations Control Center (POCC) Cadre MITP was implemented in 1988. The MITP consolidates mission independent training into one formal program to avoid duplication of effort and promote the efficient use of training resources. The standard curriculum requires a combination of workbook, classroom, and hands-on or on-the-job training. By using the curriculum guide, supervisors and employees can determine the requirements for each position and initiate their own training program. A computer program aids in tracking the trainees' progress and advising supervisors of the status.

Benefits Achieved:

The use of the MITP should save an average of 4.8 man-years per year or approximately \$144,000 per year. The benefit of having a fully-trained cadre, however, cannot be calculated. This will be evidenced by the better support of flights.

Contact for more information:

Homer Hickam
205/544-2194

36. Rewards for Scientific, Engineering, and Technical Personnel

NASA Headquarters (Code C)

Description of the Activity:

Since enactment of P.L. 99-502, the NASA Inventions and Contributions Board (ICB) has granted monetary awards in 167 cases, amounting to over \$341,000 to NASA and NASA contractor personnel for their scientific and technical contributions to aeronautical and space activities. The amounts awarded in 12 of the 167 cases were influenced by the degree of technology transfer and commercialization achieved for non-aerospace industrial purposes.

Benefits Achieved:

Rewarding people for accomplishments increases incentive and boosts morale. In addition, this particular award influences support for private sector efforts.

Contact for more information:

Henry Clarks
202/453-8722

37. Distribution of Patent Royalties

NASA Headquarters (Code C)

Description of the Activity:

NASA was the first Federal agency to distribute its patent royalty income as required by P.L. 99-502. In June 1988, the United States Treasury was instructed to prepare and mail checks totaling \$56,944 to 35 present and former NASA employee-inventors in payment of their share of NASA's patent royalty income received between the effective date of the Federal Technology Transfer Act of 1986 (October 20, 1986) and December 31, 1987. The amount distributed represents approximately 70 percent of the \$80,744 in royalties that NASA received during this period.

Benefits Achieved:

Distributing patent royalties is a great incentive for encouraging innovation and

development of new ideas and technologies. Encouraging creative thinking improves organizational morale and promotes improved quality and productivity throughout NASA and the country.

Contact for more information:

Henry Clarks
202/453-8722

38. Incentive Award for Property Custodians

NASA Headquarters (Code DB)

Description of the Activity:

In 1988, in conjunction with the Incentive Awards Program outlined in HQMI 3451.1B, the Logistics and Transportation Support Branch instituted an annual award to encourage and reward excellence among Headquarters property custodians. The Property Custodian Outstanding Account Management Award is based on selection criteria extracted from the custodian responsibilities cited in the NASA Equipment Management Systems (NEMS) User's Guide.

Benefits Achieved:

NASA Headquarters currently maintains about \$41.7M of accountable equipment. By recognizing the level of responsibility and effort of the property custodians, the administration emphasizes the importance of property management. This results in, for example, increased productivity and effective use of funds/resources (equipment), resulting from tighter surveillance of equipment (less misplacement or theft); an increased awareness of untagged equipment found on station; and better use of resources when inactive equipment is identified and turned in to the Property Disposal Officer for reissue or excess.

These benefits, in turn, help administration by eliminating the need to prepare survey reports for lost, damaged, or destroyed equipment; decreasing the need to convene the Property Survey Board to determine findings on the survey reports; and eliminating delays in inventories when property is missing or untagged equipment is found on station.

The cost of managing and controlling NASA's equipment is reduced through the awareness of responsibility by all employees for the proper use, care, and protection of all Government equipment under their custody.

Contact for more information:

Christine R. Williams
202/453-1810

39. Headquarters Employee Relocation Program

NASA Headquarters (Code DP)

Description of the Activity:

Code DP conducted over 100 employee relocations under the auspices of civil service and contract relocation specialists and assistants. This joint effort between the Headquarters Human Resources Management Division and Carol Lucas Associates successfully managed the process by which employees permanently change duty stations.

Benefits Achieved:

This process resulted in a significant decrease in time associated with completing real estate transactions and reporting to the new Headquarters work site. The counseling efforts substantially improved the understanding and use of the several entitlement and service programs offered to relocating employees.

Contact for more information:

David Cushing
202/453-8588

40. Supervisory/Managerial Training

NASA Headquarters (Code DP)

Description of the Activity:

Supervisory/managerial training encompassed staffing, performance appraisal, awards, employee development, and employee relations. One of the training sessions was held at the Space Station Freedom Program Office in Reston, Virginia.

Benefits Achieved:

Increased knowledge and skills for managers and supervisors in the field of human resources leads to enhanced utilization of employee capabilities.

Contact for more information:

Elaine Maxwell
202/453-8488

41. Manned Flight Awareness (MFA) Activities

NASA Headquarters (Code M)

Description of the Activity:

The Manned Flight Awareness (MFA) Program communicates to Government and industry employees that they are NASA's greatest asset and recognizes that they are working on hardware/software that is critical to the Nation's space program. The primary objective of the MFA Program is to help ensure mission success and astronaut safety through employee awareness. During 1988, the MFA Program sponsored Honoree events at JSC and KSC recognizing Government and industry employees for outstanding contributions. The Program also sponsored astronaut appearances at NASA centers, contractor and subcontractor plants, and vendor facilities for motivational purposes and to present "Silver Snoopy" awards to members of the work force for outstanding performance in support of space flight activities. In addition, motivational materials, including a special STS-26 Kit heralding the safe return-to-flight of America's Space Shuttle were distributed to the NASA/Government/industry work force.

Benefits Achieved:

The MFA Program works to improve the morale of the NASA work force and, through the joint participation of employee/management in all MFA activities, helps to reinforce the important concept of teamwork.

Contact for more information:

Diana Chaney
202/453-8642

42. Space Shuttle Recovery Awards Ceremony

NASA Headquarters (Code M)

Description of the Activity:

In December 1988, the Office of Space Flight sponsored a special Honor Awards Ceremony recognizing both Government and industry employees who worked long and hard to launch the rebirth of America's manned space program. More than 600 employees received special recognition for their outstanding contributions to the Space Shuttle recovery effort. In addition to the Headquarters Ceremony, with Dr. Fletcher, Mr. Myers, and Astronaut Frederick Hauck participating, there were also ceremonies held at each of the centers with Admiral Richard H. Truly, Associate Administrator for Space Flight, presenting these awards and offering his personal thanks to each individual for the successful recovery effort.

Benefits Achieved:

This activity, certainly an effective motivational tool, provided an excellent opportunity to thank each of the dedicated workers on the NASA team who made the safe return to manned space flight possible. In addition, this ceremony communicated to Government and industry employees that America's return to space with the successful mission of the Space Shuttle Discovery attests to our Nation's ability to overcome adversity and to the skill and determination of the NASA team.

Contact for more information:

Renee S. Green
202/453-2544

43. Instructional Courses - Program/Project Management

NASA Headquarters (Code ND)

Description of the Activity:

Three courses aimed at improving the knowledge and skills of the NASA work force involved in program and project management were delivered. Two of the courses, Systems Engineering and Program Control, were designed to improve employee performance in these management areas. The Advanced Project Management Course was developed for employees at the systems level. All the courses use contractors, NASA employees, and NASA alumni as presenters. Some of the sessions are in panel format to facilitate an exchange of experiences and lessons learned with veteran management personnel.

Benefits Achieved:

The design of the courses facilitates documentation of the past experiences and lessons learned from NASA and contractor personnel. Because the courses are agencywide, they provide a common lexicon of program/project terminology that is NASA- and center-specific. This is a feature that had not been available in the industry off-the-shelf courses. The initial course evaluations indicate a high degree of acceptance and knowledge transfer among the participants.

Contact for more information:

Frank Hoban
202/453-8906

III. IMPROVED METHODS/PROCEDURES

44. Automated General Ledger System

Ames Research Center (ARC)

Description of the Activity:

Center accomplishments and benefits sometimes result from building on innovations or lessons learned elsewhere - the ARC Automated General Ledger System is modeled on a similar system at Lewis. Ames is using its automated system to record General Ledger data and to generate reports to meet NASA Headquarters requirements for General Ledger reporting.

Benefits Achieved:

The change from a manual process to an automated system has resulted in savings of approximately one-quarter resource year of effort. Also, reports are produced on a more timely basis.

Contact for more information:

Kevin Werner
408/464-5312

45. Teaming for Productivity Improvement

Ames Research Center (ARC)

Description of the Activity:

The "teaming" efforts between a civil servant safety manager and a BAMSI Project Administrator resulted in a reduction of the amount of hazardous waste removed from Machine Shop at Ames. The safety manager identified the problem of 1,000 gallons of contaminated coolant that had to be disposed of every 3 months as a hazardous waste. The Contractor Project Administrator proposed a solution, which was written up as a formal recommendation. As a result, three Space Age Solutions - ROSS (Remote Oil Skimmer Systems) devices were designed, manufactured, procured, and installed for testing in preparation for fitting the entire Machine Shop with the devices.

Benefits Achieved:

In reducing the amount of hazardous waste removed from the Machine Shop, this teaming effort saved ARC \$6,000 per year.

Contact for more information:

Ken J. Skelly or Robert C. Stevens (BAMSI)
408/464-6978 408/464-6049

46. Dual Mission Control Centers

Ames Research Center (ARC)

Description of the Activity:

In 1988, the Western Aeronautical Test Range completed development of a dual-mission support capability at the Dryden Flight Research Facility. This means there are now two Mission Control Centers to support research and test flights.

Benefits Achieved:

The ability to fly two missions simultaneously provides scheduling flexibility. It also allows system setup, combined system tests, and installation and checkout of system modifications to occur without impact to a mission in progress. It provides redundancy such that one system is available for backup. Since flight missions can consume considerable resources and require extensive preparation, the flexibility and redundancy afforded by dual capability means improved use of resources.

Contact for more information:

Donald C. Rhea
805/961-3242

47. Productivity Award Fee Provisions

Ames Research Center (ARC)

Description of the Activity:

To encourage contractor participation in the center's productivity improvement program, award fee provisions for productivity have been included in two recently awarded support service contracts. These provisions set aside a portion of the award fee pool for productivity initiatives submitted to their respective Performance Evaluation Boards for approval. If the initiative demonstrates a possibility for a significant net savings (such as time and dollars), the initiative is approved. Success is measured against the agreed to performance goals included in the approved initiative. Award fee dollars are based on the actual achievements made.

Benefits Achieved:

The productivity award fee provisions have effectively stimulated interest as each contractor has submitted several initiatives pursuant to the productivity award fee provisions of their individual contracts.

Contact for more information:

Jana M. Coleman
408/464-5820

48. Research in Bayesian Classification-Auto Class

Ames Research Center (ARC)

Description of the Activity:

The AutoClass Project is a long-term research program in the development of theoretical methods for automatic classification of complex and noisy data, as well as a practical effort in tool building to implement the theoretical work. The basis of the research is the Bayes's theorem, a well-known artificial intelligence method for reasoning about uncertainty by use of probability.

The work is a collaboration effort of computer scientists and mathematicians in the ARC Artificial Intelligence Research Branch and scientists with complex data bases in other domains. The current implementation, AutoClass II, has been applied with great success to a very large data base containing spectral information from the Infrared Astronomy Satellite (IRAS). It has shown the ability to outperform human astronomers in the discovery of new knowledge from that data base.

Benefits Achieved:

The application of AutoClass II to IRAS data has resulted in a new catalog of infrared spectral objects jointly proposed by computer scientists and infrared astronomers. A major advantage of the approach to prior automatic data analysis programs is that noise is treated as noise and does not result in spurious classifications where none exist in physical reality.

Since NASA missions result in massive amounts of data, this problem will increase with future scientific missions that have information transfer bandwidths order of magnitude greater than prior missions. AutoClass II has already demonstrated its utility as a tool for analysis of such data in explaining new physical phenomena to maximize the science yield of missions. Future versions of the system will help solve even more difficult problems involving reasoning about time dependencies.

Contact for more information:

Peter Friedland
415/694-4277

49. The Neutral Buoyancy Test Facility

Ames Research Center (ARC)

Description of the Activity:

The Neutral Buoyancy Test Facility (NBTF) is an underwater test facility that provides simulation of a weightless environment for development and testing of space suits, related equipment, and procedures for use in space flight. NBTF operations are unique in that a typical operation requires only four support crew plus the suit test subject. The NBTF crew consists of a primary safety diver; a back-up safety diver, who doubles as suit technician; a hoist operator; and the test director, who also monitors and controls the life-support system. This streamlined approach contrasts with other operations where support crew requirements for typical operations range from 8 to 20 personnel.

In addition, all NBTF crewman are researchers within the Crew Research and Space Human Factors Branch. Thus, the crew brings individual areas of expertise to each evaluation, which enhances the operation; and as researchers, each has the opportunity to evaluate his or her project in a simulated weightless environment. Gaining an understanding of the zero-g environment is fundamental to designing Extravehicular Activity (EVA) hardware. The Ames NBTF is the only underwater man-rated test facility dedicated solely for research.

Benefits Achieved:

The NBTF operation, composed of four support personnel, is a streamlined, cost-effective approach to underwater simulated weightless testing. Having a support crew composed of researchers creates a valuable resource that enhances basic EVA research in two ways: crew expertise improves each NBTF operation, while the simulated weightless experience gained creates a fundamental understanding of the zero-g environment for the researcher.

Contact for more information:

Captain Al Reinhardt
408/464-6728

50. 100% Success of Sounding Rocket Vehicles

Goddard Space Flight Center (GSFC)

Description of the Activity:

The Sounding Rocket Program supported 32 scientific sounding rocket missions in 1988 with vehicles and launch vehicle hardware including ignition systems, recovery systems, thrust termination systems, payload separation systems, and ejectable nose cones. The NASA Sounding Rocket Program utilizes 13 operational solid rocket launch vehicle configurations, and 11 of these 13 systems use 20- to 30-year old surplus military rocket motors.

Benefits Achieved:

These launch vehicles and systems were 100 percent successful. The performance is a truly remarkable record of production, reliability, and quality control. This was accomplished even though systems were shipped to and launched from several locations around the world, such as: Norway, Sweden, Australia, Alaska, and New Mexico. It was necessary to overcome hardware shortages and delivery delays in providing these systems to meet tight schedules.

These rocket motors are explosive, hazardous, and sensitive to handling and environmental conditions. The support and oversight of personnel in the procurement, storage, integration, shipping, and launch operation of these systems made this successful record possible. This garners for NASA and the science community "a lot of science" at minimal cost using existing resources (rockets).

Contact for more information:

L. Warren Gurkin
804/824-1566

51. Efficient Small Shuttle Payload Accommodation Capability

Goddard Space Flight Center (GSFC)

Description of the Activity:

The purpose of the Shuttle Solar Backscatter Ultraviolet (SSBUV) experiment is to provide calibration checks of the atmospheric ozone monitoring instruments (SBUV/2) being flown on the National Oceanic and Atmospheric Administration series of polar orbiting satellites. This requires that SSBUV fly about once per year. Therefore, a quick turnaround capability is needed. SSBUV was designed as a standalone system with minimum use of Shuttle utilities. This was achieved by developing a self-contained power, data, and command system based on low cost Get-Away-Special (GAS) technology.

The SSBUV experiment consists of two GAS canisters. One canister contains the instrument, a microprocessor, and signal conditioner. The second contains the data acquisition system; tape recorders; and the power system, consisting of batteries and regulators. The experiment can be operated at three levels: (1) the instrument alone, (2) the instrument integrated with the data system, and (3) the flight payload configuration. In flight, the payload is commanded through a small payload command unit that is routinely flown on the Shuttle.

Benefits Achieved:

This payload configuration has several benefits. The experiment can be easily tested at the component and system levels. Installation on the Shuttle is easy to accomplish since the interfaces have already been defined and flown. The standalone capability allows a quick turnaround from one flight to the next. This capability allows for flight in a variety of Shuttle cargoes resulting in an ability to fly on a regular basis. SSBUV is scheduled for four Shuttle flights between 1990 and 1993.

Contact for more information:

Ernest Hilsenrath
301/286-6051

52. Manufacturing and Machining Techniques - Tutorial for Design Engineers

Goddard Space Flight Center (GSFC)

Description of the Activity:

Many engineered designs, derived from strength, functional, or geometric considerations, are impractical or impossible to produce from standard or available machining practices and/or materials. This is often a result of the design engineer's lack of knowledge regarding standard manufacturing processes. An Engineering Directorate employee suggested establishing a manufacturing and machining techniques tutorial for design engineers. An inter-agency tutorial series was then developed in which Machine Shop employees (such as machinists and welders) educate GSFC design engineers about available machining capabilities and materials. An informal seminar environment fostered communication and encouraged manufacturers to pinpoint common or recurring design features that made their jobs more difficult and time consuming.

Benefits Achieved:

This tutorial/seminar has proven to be of tremendous value by saving the Directorate money, materials, and man-hours. Design engineers have created better initial designs, which reduces time spent on revisions. The seminars have enhanced interaction between

engineers and shop personnel. The program has increased employee motivation and unity, and has boosted morale for the shop personnel.

Contact for more information:

Cathy L. Dankewicz
301/286-8893

53. NOAA-K, L, M Performance Measurement System Improvement

Goddard Space Flight Center (GSFC)

Description of the Activity:

Previously, Performance Measurement System/Cost/Schedule Control System (PMS/C/SCS) reporting by General Electric (GE)/Astro, East Windsor, for the Defense Meteorology Satellite Program (DMSP) was done in a very cumbersome and paper-intensive manner. Also, C/SCS reporting was scheduled for the full period of performance, including all Integration and Test (I&T) and Launch Support. This method of reporting was proposed by GE/Astro, East Windsor, for the National Oceanic and Atmospheric Administration (NOAA)-K, L, M contract at a cost of \$3.8M.

Benefits Achieved:

The Metsat Project initiated an effort to reduce PMS reporting costs for the NOAA-K, L, M contract. This included utilizing GE/Astro's internal DEPICT System in a more efficient manner and switching to 533 reporting, instead of PMS reporting, after I&T was initiated on NOAA-M. These improvements were monitored by the Code 150 PMS office. As a result, the cost savings amounted to approximately \$1.4M. Some of these new methods may be applicable to other GSFC contracts at GE/Astro, East Windsor.

Contact for more information:

Steve Dobrosielski
301/286-5634

54. Procurement Productivity Demonstration Project (PPDP)

Goddard Space Flight Center (GSFC)

Description of the Activity:

The GSFC Procurement Productivity Demonstration Project (PPDP) consists of 8 recommendations that are selectively applied to competitive negotiated procurements in

excess of \$1 million. The Project commenced in 1987 and was to be conducted through 1989. However, authority was requested to extend the PPDP through at least 1991.

Of the 42 procurements that were included in the PPDP during 1987-88, 15 were completed in 1988; 8 were deleted because they were made noncompetitive or because the requirement was cancelled; work on 6 was not started for reasons unrelated to the procurement process. The remaining 13 were in various stages of completion during 1988. Additional PPDP procurements have been identified for 1989.

Benefits Achieved:

A comparative analysis of the 15 procurements completed in 1988 with the pre-PPDP period of 1985-86, shows a lead-time savings of over 100 days for Source Evaluation Board (SEB)-level procurements and over 40 days for procurements in excess of \$1 million but less than SEB-level in dollar value. The associated labor savings is estimated at 26 to 30 man-years.

Contact for more information:

Kent Cockerham
301/286-2812

55. HST Control Center Mission Operations Control Room Display System

Goddard Space Flight Center (GSFC)

Description of the Activity:

Growth in the requirements to support the Hubble Space Telescope (HST) operations had resulted in the display system becoming saturated leaving no expansion capability. The original display system was based on 1970's technology with limited resolution and CRT glare causing eye fatigue. A detailed engineering study and prototype effort determined that a work station approach would increase the amount of data that could be displayed at a single operator position. This approach also would provide a path to future growth in areas, such as the operator/machine interface. The implementation required that the upgrade be accomplished in parallel to ongoing HST prelaunch test activities without disruption to critical support schedules. The effort was performed by the Mission Operations Division and the Ford Aerospace Corporation.

Benefits Achieved:

The new display system was installed on time and immediately was able to support continuing spacecraft testing and operations training. Four times as much data can now be displayed by each operator monitoring the HST health and safety. New display techniques allow specifying the desired data page by using a "mouse," which relieves the operator of typing the data page "name." This reduces mistakes that would delay the

display of critical data. Also, access to previously defined and stored procedures that generate spacecraft commands allows the operator to verify the applicability of a procedure before it is executed, reducing the likelihood of a mistake during operations.

A path now exists to achieve even greater productivity improvements. Currently, efforts are underway to employ "expert systems" techniques that would alert the operator to spacecraft faults and provide key information concerning the cause of the fault. There is also potential for enhancing the system to take corrective action based on the failure. These features would result in fewer operators being able to monitor spacecraft with greater accuracy.

Contact for more information:

Carroll Dudley
301/286-6228



New Hubble Space Telescope Control Room Display System

56. Automated Asteroid Search

Jet Propulsion Laboratory (JPL)

Description of the Activity:

Improvements in the ASTENC and SELECT computer programs have automated the search for potential asteroid and comet flyby candidates for deep space missions. The programs identify asteroids that pass within a specified distance from a spacecraft trajectory and organize the summary information on each encounter into a table that can be sorted by asteroid number, size, miss distance, and injection or arrival date. The table then can be used by commercial computer programs, such as Lotus, to plot trajectory parameters to identify the best potential flyby candidates.

Benefits Achieved:

The automated asteroid search process greatly reduces the effort required by a mission design analyst to identify potential asteroid flyby candidates. The process is useful for deep space missions such as Galileo, Comet Rendezvous and Asteroid Flyby (CRAF), and Cassini.

Contact for more information:

Jennie Johannesen
818/354-3352

57. Automated Requirements Management System

Jet Propulsion Laboratory (JPL)

Description of the Activity:

The Program Requirements and Assessment Office at JPL has led the design and development of the Automated Requirements Management System (ARMS) for the Space Station Freedom (SSF) Program. The purpose of this system is to record program and system-level requirements, and the linkages between them. It provides a clear, complete, and nonredundant set of requirements that is being implemented for the design, development, and test activities of the program. When completed, ARMS will complement the traditional program requirements documentation and will lead in activities related to requirements traceability, completeness analysis, system verification and change analyses, and many other tasks related to the huge number of requirements that define the SSF.

ARMS is a multi-user relational data base application that operates under the program's Technical and Management Information Service (TMIS), interfacing to the configuration management and documentation systems, verification and engineering data bases, and supporting design knowledge capture. The system supports NASA Headquarters, the Space

Station Program Office, involved centers, Work Package contractors, and the international partners. Development will continue over the next year or more to enhance system capability and expand its availability.

Benefits Achieved:

ARMS supports and encourages the development of a clear, unambiguous set of requirements. It eliminates the need for developing traceability matrices more than once; and automatically indicates where requirements are duplicated, ambiguous, not addressed, or improperly derived. Multiple views of the data set provide significant productivity benefits by allowing diverse users to be represented without duplication and eliminating a large amount of documentation.

Contact for more information:

Geoffrey Giffin
703/487-7212

58. Automated Sequencing Aid

Jet Propulsion Laboratory (JPL)

Description of the Activity:

Software referred to as PLAN-IT in the prototype and proof of concept stages was implemented for multi-mission use. It was designed to greatly increase productivity by relieving users of mundane, time-consuming conflict checking, and sequence editing tasks. This highly interactive timeline format sequence editing tool incorporates significant conflict detection and display capabilities.

Benefits Achieved:

This newly developed software will save approximately \$4.5 million during the Comet Rendezvous and Asteroid Flyby (CRAF) and Cassini missions. It is estimated that subsequent missions will experience similar savings. In addition, the sequences produced with the planner will be of a substantially higher quality than is possible with conventional tools and manual labor.

Contact for more information:

Thomas Starbird
818/354-1033

59. Automatic Space Flight Operations Schedule Generator and Editor

Jet Propulsion Laboratory (JPL)

Description of the Activity:

An object-oriented graphics editor was written to simplify the daily production of the Space Flight Operations Schedule (SFOS). The editor runs on a Sun workstation, using the SunView window package; and produces hard copy with a laser printer. Each graphics object is defined by a limited set of parameters. For example, an object is defined by the name of the event, a time, the vertical placement on the chart, and the symbol to plot. The SFOS, which can be stored daily as a text file, is an index to the Sequence of Events File (SOE). An awk (a pattern-matching language program) was written to scan the SOE, pull out events, sequence and antenna track, and place them in the SFOS file.

Benefits Achieved:

The SFOS form is now visible on the screen, making the process simpler and more reliable. Events are extracted automatically from the SOE files and are available when the technician first brings up the SFOS file for a specified day. Automatic placement of events in correct timeline position has eliminated alignment errors. The editor prevents user errors such as invalid time entry or improper object location. Legend variables on the right side of SFOS form are calculated automatically by the awk program; thus, eliminating a common source of errors. An existing SFOS can be changed to smaller timeline display scales, which avoids errors and reduces production time.

Contact for more information:

Kevin Miller
818/354-0095

60. A Data Base for Source Evaluation Board Procurements

Jet Propulsion Laboratory (JPL)

Description of the Activity:

An extensive data base has been developed to track the proposals received relative to a Source Evaluation Board. Also, a system has been designed to track strengths, weaknesses, scores, adjective ratings, and questions and responses at either the criteria or subfactor levels for each proposer.

Benefits Achieved:

Impartial evaluations are ensured through consistency checks of scoring, and tabulation of the number of questions posed to probe weaknesses and validate strengths. The data base

provides detailed information for proposer debriefings. This data base also enables rapid generation of reports with less preparation effort and greater flexibility in combining information.

Contact for more information:

Sandra Dixon
818/354-3289

61. A Multinet Gateway with a Guard Feature

Jet Propulsion Laboratory (JPL)

Description of the Activity:

As part of the Command and Control Automation Project, host computers were designed to allow access to telecommunications nets that employ various protocols. The different nets allow both datagrams and data packets to be routed selectively and restrictively, based on criteria established for each net and between authorized subscribers. The multinet gateway with the guard feature then allows only authorized and known users to communicate with one another. The gateway provides the necessary interface between the computers and telecommunications nets to prevent unauthorized intrusion into the data bases on the operating system.

Benefits Achieved:

The primary benefit of this device is that sensitive and classified data exchange can be processed without a significant risk of exposure to compromise. Implementation of the features of this device could protect the JPL and/or NASA data bases from unauthorized intrusion or access by viruses or hackers.

Contact for more information:

James Tribbett
818/354-7386

62. Reduced Space Requirement for Optical Design Tape Library

Jet Propulsion Laboratory (JPL)

Description of the Activity:

The new NASA initiative in optics technology required a tenfold expansion in computer-aided optics system design and analysis. As a result, the library of optical designs

and ongoing engineering designs required 1,500 magnetic tapes (2,400-foot each) and a 120-square foot room dedicated to storage. The new technology of digital videotape cassettes was investigated as an option for reducing storage space.

Benefits Achieved:

The optical tape library was converted to 8-mm helical scan digital videotapes. A small bookcase now provides storage for the library. Tape storage is collocated with the computer operator and engineer, which saves approximately 40 minutes of work time per day.

Contact for more information:

James Breckinridge
818/354-6785

63. Telerobot Interactive Planning System

Jet Propulsion Laboratory (JPL)

Description of the Activity:

As part of the JPL telerobotics effort, software was designed and developed to operate in either an interactive or autonomous mode to develop adaptive plans that are faster than real-time and can be executed by multi-armed robots in a semi-static spatial environment. The software package includes a task planning component, a kinematic simulator, and a graphic interface.

Benefits Achieved:

This software enables autonomous, adaptive robot planning and appears to be the first fully integrated adaptive task planning and spatial planning system that can operate faster than real-time while autonomously recovering from errors. The technology will apply to the Space Station robot assembly and servicing tasks as well as to future planetary rovers and highly autonomous software.

Contact for more information:

Steve Peters
818/354-1137

64. Improved Methods for Facilitating Earth Observations

Johnson Space Center (JSC)

Description of the Activity:

Lockheed and JSC scientists of the Space Shuttle Observations Office have developed an improved technique for planning Earth observation opportunities by astronauts. Recently implemented on STS-26, the Automated Mission Planning System (AMPS) is a computer system that uses PC-based software. This system supports the Space Shuttle Earth Observations Project (SSEOP) pre-mission, real-time, and post-mission functions. AMPS capabilities encompass calculation of orbit crossings and sun elevation data for standard Earth Observation Sites, generation of the Final Site List, and production of the Mission Elapse Time (MET) List. The plotting capabilities include customized orbit maps--daylight, awake, night, all orbits, sub-glitter, post-mission actual orbits, and photograph-Orbiter nadir points. Real-time mission support, updated with current state vector inputs is expanded to include MET List updates and revised orbit maps. An archival data base tracks the site/mission history, providing valuable information for future site selections.

Benefits Achieved:

The benefits of AMPS include automated compilation of the Final Site and MET Lists, map plotting of the ascending nodes, sunrise terminators, site polygons, site selection, and data transfer. Prior to AMPS, maps of photographic sites were produced manually 6 to 8 weeks prior to launch, using parameters generated 4 to 6 months in advance. AMPS enables the SSEOP to produce maps expeditiously (within hours of receiving state vector and launch time information) in support of astronaut crew planning activities. AMPS development is also a contributing factor toward the enhancement of the SSEOP pre-flight manual--a mission-specific reference tool delivered to the astronaut crew prior to launch which details photographic procedures and techniques and in-depth site descriptions.

AMPS is time-effective, reduces the possibility of error, improves SSEOP product quality, and is adaptable to related applications.

Contact for more information:

Eric Nielsen
713/483-4786

65. Animation Capability Added to Human-Modeling Software

Johnson Space Center (JSC)

Description of the Activity:

Technicians in the Graphics Analysis Facility (GRAF) at JSC enhanced their existing human-modeling software package (also referred to as PLAID) with an animation capability. This improved the overall effectiveness of computer-aided engineering (CAE) and human factors analyses. This capability significantly extends the detail level and quality of analysis output. However, it requires greater initial user set-up and computer processing time than the simple "snapshots in time" CAE views. Modifications to the software program were devised to make the process more interactive and user friendly to compensate for the additional overhead time.

Benefits Achieved:

The animation capability significantly increases the range of in-depth analysis of design concepts and mission tasks. Animation allows designers and mission planners to evaluate human interaction with spacecraft elements by studying continuous motion at discrete intervals rather than coarse evaluation through the single "snapshot in time" approach. The result is improved identification of design and task issues through visual analysis.

Contact for more information:

Linda Orr
713/483-3722

66. Development of Technique to Inspect Rocket Thruster Injector Flow

Johnson Space Center (JSC)

Description of the Activity:

JSC engineers in the Propulsion and Power Division have developed an injector flow inspection device to more easily assess the condition of the injector flow passages of the Space Shuttle primary reaction control system thruster. For a thruster to properly operate, it is critical that the flow streams of propellants are uniform. Previously, there was no available mechanism to accurately evaluate the quality of the injector flow streams produced in an already-assembled thruster. Now, through the use of a readily available fiber optic scope, the passages of the propellant flow streams are being tested and analyzed to determine their quality for use on future flights.

Benefits Achieved:

This technique has been used to recover six severely contaminated development thrusters to a fireable condition; thereby, avoiding replacement costs of \$1 million each. The device also has been used by the thruster manufacturer to investigate suspected flow abnormalities in flight thrusters.

Contact for more information:

Dennis L. Wells
713/483-9012

67. Improved Inspection Criteria for Testing Quality of Orbiter Thermal Control System Blankets

Johnson Space Center (JSC)

Description of the Activity:

There are 3,600 thermal insulation blankets used throughout each Orbiter to protect the structure, systems, and payloads from the thermal environments of ascent and entry. The blankets, composed of fibrous material, provide a uniform radiative heat sink for the Orbiter skin during on-orbit operations. The fibers are susceptible to crushing due to inappropriate handling or inadvertent compression loads, resulting in diminished levels of thermal effectiveness. The original inspection technique to detect crushing damage was to feel for compressed fibers manually.

Meetings were held with Lockheed Engineering and Sciences Company, KSC, JSC, and the Rockwell Space Transportation System Division (STSD) thermal engineers to determine the acceptability of the subjective "feel" technique. It was decided that an objective means should be developed for measuring the extent of crushing. Subsequently, a needle device and a modified dial indicator measuring tool were developed. A requirement of 90 percent of the design thickness was proposed by Rockwell STSD. Subsequently, JSC initiated a test program to determine the precise degree of crushing allowable without compromising the thermal design of the Orbiter or payloads.

Benefits Achieved:

The results of the JSC tests indicated that the thickness requirement could be lowered to 60 percent of the design thickness without significantly affecting the thermal performance of the vehicle. By using the 60 percent standard, a large number of insulation blankets were acceptable that otherwise would have been replaced. A review of 1,200 thickness measurement test reports found that 727 OV-103 blankets passed the 60 percent criterion, but would have failed the 90 percent thickness requirement. Applying this ratio of failures to the number of blankets for OV-103 (STS-26) yields a total of 2,181 blankets not needing replacement. The cost of replacement (including the required documentation) is

conservatively estimated to be \$4,000 each, representing a cost avoidance of \$8,724,000 for OV-103. The blankets for OV-104 were not as damaged as those for OV-103; therefore, the additional cost avoidance is estimated to be about \$4,000,000. The combined cost avoidance for OV-103 and OV-104 totals \$12,724,000.

Contact for more information:

Luther D. Palmer
713/483-8877

68. Laboratory Resources Management/Scheduling System

Johnson Space Center (JSC)

Description of the Activity:

Cost tracking, scheduling, and control of over 125 projects at the White Sands Test Facility (WSTF) previously required lengthy meetings and review of cumbersome computer printouts to determine cost status. This process was costly due to the time needed by managers to review their activities; and decision-making was impaired by incomplete project status information.

A data management system has been developed that provides weekly project status in consolidated form. An associated spreadsheet extracts cost information from the site business computer and plots the information graphically. These data are available to project personnel on a weekly basis via the site network and PC workstations.

Benefits Achieved:

The data base system provides rapid project and manpower status that can be reviewed in a single 1-hour weekly management meeting for a savings of 2 man-year equivalents (MYE) per year. Projects are more efficiently managed and there is less retesting involved. The cost tracking system requires less than 4 hours per week to maintain and provide the plots, which saves over 100 man-hours per week. Over \$350,000 has been saved since initiation of the system in 1987. It is anticipated that this system will save approximately \$230,000 per year in the future. Additional benefits include:

- More efficient utilization of personnel, allowing more tests to be performed with the allocated resources.
- Greater capability to predict and solve problems before they become serious.
- Increased focus on technical rather than administrative activity.

- Substantially reduced potential for cost overruns.
- More efficient operations overall.

Contact for more information:

David L. Pippen
505/524-5722

69. Hazard Communication Program Enhancements

Kennedy Space Center (KSC)

Description of the Activity:

The Hazard Communication Program was modified to improve the method of communicating the nature of work place hazards to employees. A Hazardous Materials Inventory Working Group (HMIWG) was established to address Hazard Communication Program improvements. The HMIWG consisted of representatives from Shipping and Receiving, Materials and Processes (M&P), Procurement, Kennedy Inventory Management System (KIMS), and Safety. This group met weekly to assist with program refinements; the end product resulted in fewer materials distributed to the worksite without appropriate hazard labeling. Additionally, a greater understanding of Hazard Communication requirements was achieved by group participants.

Safety requirement statements were established for hazardous materials used by the McDonnell Douglas Space Systems Company (MDSSC)-Payload Ground Operations Contract (PGOC) employees. A standardized format for statement preparation has been developed to maintain consistency. The statements identify the personal protective equipment and safety requirements for hazardous material use. These statements are now included in all work documents to assure that employees are afforded the utmost safety during hazardous material usage. A rewrite of MDSSC-KSC Detail Processes (MDPs) was initiated to update safety requirements for specific tasks.

Additionally, a system has been established to transmit current hazard classifications to Materials and Processes (M&P) to assist in maintaining the current MDP-0303, Labeling Requirements for MDSSC Chemicals and Supplies.

MDSSC provided extensive assistance in revising the safety Standard Operating Procedure (SOP), Special Materials Control. The combined MDSSC/NASA effort resulted in an updated SOP similar to the requirements contained in the MDSSC-KSC Hazard Communication program, which will benefit MDSSC-KSC employees supporting NASA Level IV activities.

Benefits Achieved:

These efforts have improved communication of the nature of the hazardous commodities and the safety requirements to the MDSSC-KSC employees supporting NASA Level IV tasks.

Contact for more information:

Laurie McManus (McDonnell Douglas Astronautics Company)
407/867-4459

70. Storage of Excess Hazardous Materials

Kennedy Space Center (KSC)

Description of the Activity:

Due to the large quantity of hazardous materials stored at KSC, a committee was formed to research possible ways to prevent accidental spills. The committee included representatives from EG&G Materiel, Safety, Environmental Health and Hazardous Waste Management. NASA personnel from Supply, Medical and Environmental Health, Environmental Management, and Safety Operations served as advisors. The work of the committee resulted in a complete re-warehousing of excess hazardous materials and storage of these materials by type (corrosive, flammable, etc.). In addition, large quantities of items that should not be sold to the general public were disposed of as hazardous waste. A procedure for turn-in of these hazardous materials was prepared and is currently in centerwide review for implementation as a Kennedy Management Issuance (KMI).

Benefits Achieved:

The results of this committee will be valuable in assuring proper handling of hazardous material at KSC.

Contact for more information:

E. W. Reinhart
407/867-3012

71. Circuit Design Simulation

Kennedy Space Center (KSC)

Description of the Activity:

New software has improved productivity in EG&G's Electronic Security Design Engineering

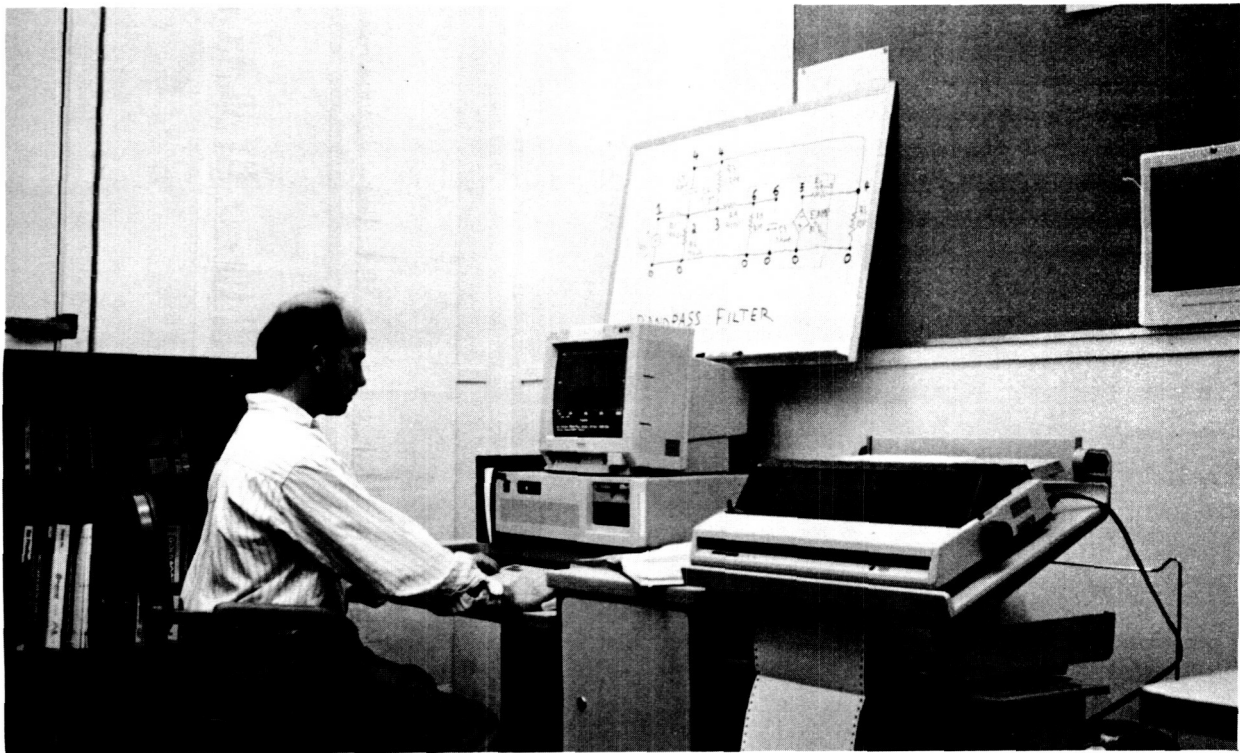
Department. The software, Personal Computer Simulated Program with Integrated Circuit Emphasis (PSPICE), is available from Microsim Corporation. The new software provides for the circuit design to be entered into the computer, and values are added to the components. The computer then simulates the circuit and provides output data in a graphic manner. By changing the component values, many variations of the circuit are tested with minimal effort.

Benefits Achieved:

The greatest benefit is the increased efficiency in circuit design testing due to the elimination of the manual prototype breadboarding. Also eliminated are the numerous mathematical calculations that previously had been necessary whenever component values changed during circuit design. The software has changed circuit design from an extremely labor-intensive process to an efficient and highly accurate design process.

Contact for more information:

Tim Mallow (EG&G Florida, Inc.)
407/853-6611



Tim Mallow improves his productivity by using a personal computer to simulate different circuit designs.

72. Secretarial Desk Reference Manual

Kennedy Space Center (KSC)

Description of the Activity:

The Secretarial NASA Employee Team (NET) from the Safety, Reliability, and Quality Assurance Directorate created a "Desk Reference Manual" to aid secretaries by providing a quick reference to information unique to the directorate. This project addressed the problems encountered by new secretaries, temporary help, and secretaries assisting other offices. The manual meets three important needs: (1) it is a teaching tool for new clerical personnel, giving detailed instructions on the proper preparation and routing of various forms and correspondence; (2) contains helpful tips for tasks done infrequently; and (3) assures that information going out of the office is complete.

Benefits Achieved:

The use of this manual decreases time spent searching for information, and reduces returns of correspondence and forms because of incorrect or missing information.

Contact for more information:

Marlene Squires
407/867-3199

73. A Method for Generating Smoothly Blended Fuselage Geometry in CDM

Langley Research Center (LaRC)

Description of the Activity:

A computer program was developed to generate smoothly blended fuselage geometry with a specified centerline camber, area distribution, and wing attachment. This program provides an automated method for creating quartic Configuration Definition Module (CDM) geometry from cambered circular fuselage wave drag geometry. This allows a mathematical representation of the geometry to be developed in less time than surface point models could be generated using previous methods.

Benefits Achieved:

Previously, wave drag models were converted to realistic geometry by using an existing computer program to interactively generate a cross-section that blended smoothly to the wing and had the desired camber line and area. This method produces a surface point model, requiring conversion to CDM format in 1 day to 1 week, depending on the model's

complexity. The current computer code generates a file readable by CDM producing a quartic, rather than surface point model in approximately 1 hour. This analytical representation is smoother than a surface point model and better suited for higher order analysis. The computer code also generates a PostScript program source code to make scaled drawings of the fuselage cross-sections on any PostScript device, such as a laser printer.

Contact for more information:

James W. Fenbert
804/864-6504

74. In-House Aluminum Powder Synthesis Capability

Langley Research Center (LaRC)

Description of the Activity:

Demonstration of Advanced Aluminum Alloys with improved properties using powder metallurgy (PM) techniques has been accomplished for several general alloy compositions. Additional research is necessary to further understand the factors relating to improved properties and to continue technology optimization. Characteristics of the starting powders (chemistry, particle size, morphology, surface condition) have been shown to affect final product properties significantly. Previously, alloy powders were obtained from commercial powder vendors, which resulted in frequent problems with quality, scheduling, and availability.

A research-scale aluminum powder gas atomizer is now operational in the experimental foundry for processing quantities of powder suitable for PM alloy research and development. The apparatus is suitable for fundamental alloy powder research as well as research on direct processing of sheet materials.

Benefits Achieved:

This in-house capability will greatly enhance the research activity related to PM aluminum alloy development, and significantly reduce the iteration time for material characterization from concept to property measurement. Also, it will allow for improved powder quality through better in-house process control. Finally, it will provide for fundamental research on aluminum alloy powder and its effect on product properties.

Contact for more information:

Dick M. Royster
804/864-3135

75. Production and Usage of Polystyrene Latex (PLS) Microspheres

Langley Research Center (LaRC)

Description of the Activity:

During 1988, the Facilities Engineering Division's laboratory continued production of polystyrene latex microspheres, primarily for use in Langley's Wind Tunnels. A total of 172.5 liters was produced. Of this amount, 90.7 liters were supplied to NASA and other government organizations including:

- 61.0 liters - Supplied to Langley Wind Tunnels.
- 7.0 liters - Supplied to NASA/Ames Wind Tunnels.
- 22.7 liters - Supplied to various Department of Defense installations, including Fort Eustis, Wright/Patterson AFB, The Johns-Hopkins University/Applied Physics Laboratory, and Arnold Engineering Center.

Benefits Achieved:

As of 1988, PSL microspheres were purchased at an approximate cost of \$4000 per liter. In-house LaRC costs to produce a 2.5-liter batch are: chemicals and storage container - \$2.07, and professional manpower - 2 man-hours. The same 2.5 liters, if purchased, would cost approximately \$10,000.

The above total of 90.7 liters, if purchased, would cost approximately \$362,800. Actual LaRC costs are approximately \$80.00 for chemicals and supplies, and 74 professional man-hours.

Contact for more information:

Cecil E. Nichols, Jr.
804/864-4096

76. Automated Data and Records Management

Lewis Research Center (LeRC)

Description of the Activity:

Automated data and records management increases efficiency and effectiveness of a wide range of applications at Lewis. For example, an automated system was designed and implemented to retrieve and update the status of inactive research and development (R&D) records at Plum Brook Station and various Federal Records Centers. This system tracks the constant turnover at the storage centers as new records are added, current records are

accessed when needed, and obsolete records are moved or destroyed. Reports are displayed online, and batch reports are produced.

Also, an in-house Computer-Aided Design and Manufacture (CADAM) program for collecting engineering drawing data and controlling CADAM-released drawings with minimal user intervention was developed. In-progress CADAM drawings are transferred automatically to the appropriate data base for verification, review, approvals, and final release. Data are entered automatically into the Lewis Drawing Record System (LDRS). The information that is stored in the data base is readily available for checking, copying, revision, and plotting for direct use by engineering and fabrication.

Benefits Achieved:

The computerized approach is far more efficient than the old manual system, and greatly facilitates the daily management of records. The printouts of the records stored at Plum Brook have been useful in conducting the first inventory in 10 years. Over 10,000 cartons of R&D records were inventoried in only 5-1/2 days.

The system also facilitates identifying and retrieving CADAM data so that data can be reused in a more productive manner. Engineers and designers can receive correct information as needed to increase productivity and reduce error potential. The in-house CADAM program also eliminates manual input of title block data into LDRS.

Contact for more information:

David J. Steigman
216/433-2914

77. Cost/Structure Analysis Interaction (COSTIN)

Lewis Research Center (LeRC)

Description of the Activity:

COSTIN is a program developed at Lewis to transfer data between different computer-aided engineering and analysis packages - between NASRTRAN (structural analysis) and EASY5 or MATRIXX (automatic control analysis). This facilitates the study of complex structures that are under automatic control. COSTIN was developed to evaluate the pointing control performance of the photovoltaic arrays and the solar dynamic module for the Space Station.

Benefits Achieved:

The program relieves the control system analyst from the development of math models for the plant. The models are provided via NASTRAN and transferred to EASY5 or MATRIXX via COSTIN. Math models for controls and for structural dynamics studies

can be identical. Thus, duplication of modeling is eliminated, changes are better coordinated, and cooperation between the controls and structural disciplines are enhanced.

Contact for more information:

R. Graham
216/433-5178

78. Research Process Improvements at Lewis

Lewis Research Center (LeRC)

Description of the Activity:

Existing research methods often cannot accommodate particular needs or requirements. New methods and procedures must be developed to add capabilities. A precision acoustic imaging system and an improved ignition system are two examples of such developments at Lewis.

The precision acoustic imaging system nondestructively interrogates the internal structure of ceramics and toughened ceramics. The system identifies porosity variations that are strength reducing and cause premature failure of ceramic components in hot sections of heat engines.

Studying the effects of a propane and methane flame under microgravity conditions demonstrated the need for a new ignition system that could be used within an aluminum pressure vessel. A system was needed that could produce a spark to the tip of the gas outlet nozzle at a sufficient distance away from the nozzle to prevent the properties of the flame from being disturbed. A conveniently packaged igniter assembly was developed to meet the dual requirements of size and spark gap distance, using commercially available parts, a commercially available enclosure, and some fabricated parts.

Benefits Achieved:

The precision acoustic scanning system identifies porosity variations in ceramics that are not observable through other methods such as x-ray analysis. The system provides quantitative results in determining microstructural features that limit strength or fracture toughness of structural materials.

Commercially available ignition electrodes do not meet the spark gap distance requirement of 25 millimeters and the pressure vessel size constraints. The new assembly allows for more effective research into the effects of a propane and methane flame under microgravity conditions within a pressure vessel.

Contact for more information:

David J. Steigman
216/433-2914

79. STAT Turboprop Design System

Lewis Research Center (LeRC)

Description of the Activity:

The Structural Tailoring of Advanced Turboprops (STAT) Design System is the result of a recent research program to determine a superior alternative to traditional propeller design practice. The STAT Design System tailors propfan internal composite construction and external geometry variables to achieve either: (1) minimum aircraft direct operating cost for full-size propellers, or (2) minimum aeroelastic differences between full-size and scaled model blades. The System incorporates the (pertinent) discipline-specific analyses necessary to evaluate parameters and enforce design constraints related to aerodynamic efficiency, stresses and frequencies, forced response, aeroelastic flutter, and acoustics.

Benefits Achieved:

The traditional propeller design process was ad hoc and involved sequential manual design iterations, typically between different design groups. This time-consuming process was subjective and expensive. The STAT Design System integrates multidisciplinary analyses and mathematical optimization into a computationally efficient package.

In one specific application to a full-size propfan, STAT achieved a substantially better final design than that obtained by the traditional process. Also, the traditional method involved significantly more man-hours of effort than the STAT process. This test case demonstrated the STAT potential for reducing propfan design cycle time and cost while producing more efficient propeller designs for lower operational cost aircraft.

Contact for more information:

Dale Hopkins
216/433-3260

80. Productivity Enhancement Center

Marshall Space Flight Center (MSFC)

Description of the Activity:

The objective of the Productivity Enhancement Facility is to improve production and

inspection processes. This dynamic, one-of-a-kind facility is a model for NASA and contractor cooperation to improve quality and productivity.

Benefits Achieved:

The primary achievements of the Facility in 1988 are as follows:

- (1) Robotic welding on the Space Shuttle Main Engine (SSME) resulted in considerable cost savings.
- (2) A new, specialized camera system eliminated the bright glare of the weld to allow inspection of characteristics not normally visible in an operation.
- (3) Weld schedules were refined and the Variable Polarity Plasma Arc (VPPA) welding personnel received "off-line" training to enhance welding of the External Tank (ET) Lox Dome Fitting [12 of 16 major weld tools at Michoud Assembly Facility (MAF) now include the VPPA welding process in ET production].
- (4) The automated Filament Winding Process Development Cell now includes the data acquisition system used during hydrotesting, and a new control system and tensioning devices.
- (5) The fabrication of graphite/epoxy Cassegrain telescope tubes and large composite rings to simulate application of sealant material into the Solid Rocket Motor nozzle-to-case joint significantly improved project office support.
- (6) The High Temperature Sealant (HTS) Research Cell was used extensively for corrosion, environmental, mechanical, and thermal studies seeking a candidate to replace the repetitive, labor-intensive PR1422 process to protect the Solid Rocket Booster from saltwater intrusion.
- (7) The complex Marshall Sprayable Ablative (MSA)-2 sensitivity study to define the optimum configuration for flight hardware spray applications resulted in specifications for MSA-2 mixing and spraying at KSC's Assembly Refurbishment Facility (in 1989, the improved MSA-2 will replace MSA-1 on the nose cap, frustum, and forward skirt).
- (8) Composite fabrication was approved for flight on the new forward GH₂ pressline fairing effective on Light Weight External Tank (LWT)-44 following investigation of composite application on this cell part.
- (9) A ceramic Thermal Barrier Coating to protect the SSME High Pressure Fuel Turbopump turbine blades and nozzle/stators from the severe thermal shock of engine start-up and shut-down was developed and tested.

Contact for more information:

Max Sharpe
205/544-2714

81. SRM Diameter Measurement Tool

Marshall Space Flight Center (MSFC)

Description of the Activity:

The profile measurement device (PMD), a precision measuring tool, has been designed and built at MSFC. The PMD measures the shape and diameter of the Solid Rocket Motor (SRM) case mating surfaces to an accuracy of better than +0.004 inch. These measurements are vital for flight safety and are used to select cases that will seal properly during launch. Also, software was developed for automatic laser calibration and tool centering to eliminate human data handling and possible errors. This software also permits hardware adjustments up to 50 feet away from the screen. The new software package provides instant access to measured results in an on-screen form. Any problem then can be corrected on the spot and the measurements repeated, as necessary.

Benefits Achieved:

Three of these new tools replaced the older, much less accurate, steel pi-tape that were being used by Morton Thiokol at Brigham City, Utah, to measure all SRM cases.

Contact for more information:

Ralph Kissel
205/544-3510

82. Electrical Cable Routing

Marshall Space Flight Center (MSFC)

Description of the Activity:

Prior MSFC programs utilized three-dimensional, high-fidelity mockups to determine the precise electrical cable routings and lengths. These mockups required design drawings and considerable effort to manufacture and assemble. Using the MSFC Computer-Aided Design (CAD) System, cable routing can be determined "electronically" in a three-dimensional design file.

Benefits Achieved:

The use of the CAD system to determine cable lengths for existing or new designs eliminates the need to build three-dimensional, high fidelity mockups. This results in substantial savings of time and resources.

Contact for more information:

Clyde Nevins
205/544-7002

83. Electronic Time and Attendance Reporting

Marshall Space Flight Center (MSFC)

Description of the Activity:

Programming for the MSFC electronic time and attendance system was completed in 1988. The system enables time and attendance data to be entered electronically by the responsible organization and transmitted via the Management Information System (MIS) network directly to the Payroll Office. In addition, a process was developed for Data General users to electronically key in the script required to log on to the system.

Benefits Achieved:

The electronic time and attendance system replaces the cumbersome and time-consuming manual entry system of individual time cards. Savings result from streamlining the initial entry process, and also from eliminating the need to hand-carry the cards to a central location and manually transfer the data into the financial management system. The newly developed electronic key-in process improves system performance and provides easy access for Data General users. These users can now log on to the system without using the confusing and cumbersome steps required for an ADABAS computer application.

Contact for more information:

H. William Hallisey
205/544-0092

84. Automated Production of Traditional Software Project Materials

Stennis Space Center (SSC)

Description of the Activity:

This project involves the use of software engineering methodologies to produce cost

effective and quality software. Specifically, 13 programs (previously produced manually) were automated to improve the efficiency of the Science Computational Section.

Benefits Achieved:

This project reduced the effort of 40 employees in the Section by an estimated 4,300 man-hours, with annual cost savings of \$130,000.

Contact for more information:

George B. Nelson (Sverdrup Technology, Inc.)
601/688-1336

85. Computerized Telecommunication Spare Capacity

Stennis Space Center (SSC)

Description of the Activity:

A computerized program was created to determine the available spare capacity in the 13 communications nodes at Stennis. The report generated is used to determine when and where new common equipment is to be added.

Benefits Achieved:

The program extracts and sorts the information needed from the master printout on a weekly basis. This reduces the time required to obtain this information to a fraction of the time required when using the previous method. The projected annual cost savings for this project are approximately \$9,500.

Contact for more information:

George B. Nelson (Sverdrup Technology, Inc.)
601/688-1336

86. Guidelines for Preparation of Equipment Requisition Packages

Stennis Space Center (SSC)

Description of the Activity:

Management identified a need to communicate the requirements for the SSC procurement process to center employees. Equipment requisition packages were often incorrect or incomplete when submitted and had to be returned to the initiator. A requisition

handbook, "Guidelines for the Preparation of Equipment Requisition Packages," was prepared to detail instructions for various types of requisition packages.

Benefits Achieved:

The handbook aids Stennis employees in reducing the number of incorrectly submitted requisitions by providing guidelines (policies, procedures, and forms) for preparing requisitions. It is especially helpful for new employees.

Contact for more information:

George B. Nelson (Sverdrup Technology, Inc.)
601/688-1336

87. Processing Aerial Film

Stennis Space Center (SSC)

Description of the Activity:

The Graphics Section was servicing and maintaining an old aerial film processing facility that was used infrequently. The cost of chemicals to charge the equipment was substantial. An analysis of the problems associated with maintaining this equipment revealed that the processing could be procured outside more economically.

Benefits Achieved:

This work is now being done by an outside supplier equipped to process this type of film on a continuous basis. The projected annual cost avoidance is \$25,728.

Contact for more information:

George B. Nelson (Sverdrup Technology, Inc.)
601/688-1336

88. Restructured Work Week

Stennis Space Center (SSC)

Description of the Activity:

Ten Pan Am Productivity Improvement and Quality Enhancement (PIQE) teams proposed and implemented pilot programs to restructure their workweek to a 4-day/10-hour schedule with alternating off days. Each team developed a management presentation prior to implementation of the pilot program identifying specific group objectives to be

accomplished such as expanded customer service, reduction in controllable absences, reduction of overtime and call-out expenditures, and less start up/stop costs. Each team identified participating members and established a schedule for the rotation of off days. Procedures to be followed in weeks containing holidays and overtime guidelines also were addressed. The teams received support from management as well as their labor union in implementing the 4-day/10-hour workweek.

Benefits Achieved:

The 4 - 10s have reduced the controllable absence rate at Stennis by 33 percent. This workweek schedule provides 50 hours of coverage per week at no additional labor costs. The overtime expenditures have been reduced substantially; and, in many shops, overtime has been eliminated. Operational support to the customer has been expanded. As a result of the expanded workday, jobs that would be disruptive to the work force are scheduled outside the normal workday; thus, eliminating environmental hazards to employees.

Implementation of the 4-day/10-hour programs has boosted employee morale and promoted team spirit, growth, and development.

Contact for more information:

Maggie Leonard (Pan Am World Services/FOS)
601/688-1866

89. Improved Resources Authority Warrant (506A) Data Processing

NASA Headquarters (Code B)

Description of the Activity:

During 1988, the Budget Operations Office (BT) Applications (BTAPP) system was completed for the agency's Research and Space Flight Contract and Data Communication appropriations. The system is used to assist in the preparation of the Status of Approved Program (SAP) Reports, which are distributed throughout the agency. It is also used to provide the Financial Management Division data on NASA's ongoing projects for Finance and Contractual Status reporting.

Benefits Achieved:

The BTAPP system has significantly reduced preparation and processing time for budget documents. In addition, financial and budget status can be obtained quickly and easily for the various projects. BTAPP has improved methods for resources and funds control and reporting.

Contact for more information:

James T. Beuis
202/453-2258

90. Centers for the Commercial Development of Space

NASA Headquarters (Code C)

Description of the Activity:

The Centers for the Commercial Development of Space (CCDSs) are nonprofit consortia consisting of universities, industry, and government working to facilitate space-based research that will lead to commercial use of space. Since the initiation of the program, 16 CCDSs, representing over 100 private sector and academic institutions have been established.

Under the auspices of the NASA-Battelle CCDS, major universities are contributing to the technical programs identified by industry as being of primary importance. The valuable contributions of the universities increase the likelihood of new space products and processes.

Benefits Achieved:

Using the CCDSs not only increases the likelihood of new space product development, but the direction of research then is driven by the needs of American industry.

Contact for more information:

Richard Ott
202/453-2121

91. Technological Achievements

NASA Headquarters (Code C)

Description of Activity:

Projects were developed, undertaken, or completed during 1988 at the following NASA Centers for the Commercial Development of Space.

1. Center for Space Automation and Robotics:

A method and apparatus for controlling humidity in enclosed environments -Uses porous stainless steel tubing through which temperature-controlled water is

circulated. Both humidification and dehumidification are capable with the same components. The process does not free water as with currently used systems.

A nutrient water supply subsystem for plants growing in a space environment - A proof-of-concept model has been constructed and data collected that validate the concept. This information is the basis for a proposed flight experiment to study the movement of water under weightlessness.

A plant lighting system based on optoelectronic semiconductor devices - Pulsing electrical power to the devices at duty cycles of 1 to 10 percent increases the efficiency of this lighting system by at least an order of magnitude over that of currently used systems.

2. Center for Advanced Materials:

A numerical model of low gravity float zone processing with the application of cadmium telluride - The numerical modeling represents a major contribution to the overall effort of developing flight experiments for the float zone growth of high quality cadmium telluride.

An effective method for producing large zeolite crystals - Discovered through ground-based experimentation in preparation for microgravity tests.

3. Space Vacuum Epitaxy Center:

A world-class Epitaxial Thin Film Research Laboratory - Contains three ultrahigh vacuum chambers with the capabilities of epitaxial growth of thin films by Molecular Beam Epitaxy (MBE) and Chemical Beam Epitaxy (CBE).

4. Technion, Inc., an industrial partner of the Center of Aerospace Research:

A Magnetic Annular Arc (MAARC) feasibility test - A MAARC thruster can produce high specific impulse values (1,550-5,000/second) at reasonable thrust efficiencies (40-50 percent) with most nonoxidizing propellants. MAARC concept was presented at the Joint Propulsion Conference.

Benefits Derived:

1. Water condensed from the air is essentially pure and could be returned to the potable water system more easily than from current systems. The nutrient and water supply subsystem meets requirements for effective plant growth. No consumables would be required for maintenance in a space-based plant growth unit. The lighting system represents a major breakthrough in providing light for plants growing in controlled environments.

2. It is expected that use of the low gravity float zone model will result in miniaturization of the accompanying experiment effort. A major impact is expected on the zeolite catalyst industry.
3. The unique existence of the only dual MBE-CBE apparatus in the U.S. affords the opportunities to terrestrially generate the flight experiments in the Space Vacuum Epitaxy Center Program.
4. Electrical systems have the potential to provide an efficient, high specific impulse propulsion system for future space vehicles.

Contact for more information;

Richard Ott
202/453-2121

92. NASA Link Program

NASA Headquarters (Code C)

Description of the Activity:

The Aerospace Research and Applications Center (ARAC), one of NASA's 10 Industrial Applications Centers, initiated its NASA "Link" program with the State of Minnesota. The "Link" program enables transfers of NASA technology to the 7,000+ manufacturing firms located in Minnesota. In addition to its diversified manufacturing base, a growing concentration of high technology firms has developed in Minnesota, especially in computer manufacturing and medical technologies. Searches of NASA RECON are included in this services to companies, which submit their requests for information through the Governor's Office of Science and Technology. Firms interested in ARAC's value-added engineering studies will be able to engage those services on an individual basis.

Benefits Achieved:

The "Link" program provides a way for private sector and research organizations to access NASA-developed technology. By working in conjunction with the State, solutions can be tailored to local situations.

Contact for more information:

Henry Clarks
202/453-8722

93. NASA Technical Briefs Publication

NASA Headquarters (Code C)

Description of the Activity:

With the privatization of NASA Tech Briefs, circulation among engineers and scientists in U.S. industry has doubled to nearly 150,000. This reflects a net growth rate of nearly 3,000 per month. Because of the increased industrial utilization and increased benefits, the number of issues has increased recently from 10 to 12 per year. To ensure that the flow of new technology reports continues, NASA has strengthened its policies to reemphasize the value of reporting new technologies, and the awards and incentives available for those personnel participating in technology transfers.

Benefits Achieved:

Feedback from U.S. industry indicates that savings by industrial clients and government users have grown and are running in the millions of dollars.

Contact for more information:

Henry Clarks
202/453-8722

94. Space Technology Hall of Fame

NASA Headquarters (Code C)

Description of the Activity:

In April 1988, the United States Space Foundation inaugurated the Space Technology Hall of Fame in Colorado Springs, Colorado. The five winning spinoffs, which were selected from nine nominated technologies, include:

- Power Factor Controller (MSFC)
- Programmable Implantable Medication System (GSFC)
- NASA Structural Analysis Computer Software (GSFC)
- Sewage Treatment with Water Hyacinths (SSC)
- Improved Firefighters' Breathing System (JSC)

The spinoff technologies originated with NASA research and development efforts in support of the space program. Each resulted from NASA's technology transfer program, combining the resources of NASA and private industry to develop a winning application.

Benefits Achieved:

The Hall of Fame publicizes NASA efforts and increases public awareness. It also furthers technology transfer and applications projects in helping to build the country's industrial capability.

Contact for more information:

Henry Clarks
202/453-8722

95. Small Purchasing Modular Furniture Contract

NASA Headquarters (Code DB)

Description of the Activity:

The Office of Headquarters Operations has awarded a Blanket Delivery Order (BDO) for installation of modular furniture at Headquarters. This operation began with the award of a "Requote" package to Herman Miller under a General Services Administration contract. This award was a first at NASA Headquarters. The Small Purchasing Unit took the initiative in making an award worth over \$1 million. The procedures and methods used are serving as an example to other installations seeking to establish a standard modular furniture contract. While the BDO is in effect (through June 1991), Logistics and Small Purchasing personnel will monitor the contract to assure timely completion of conversions within budgetary constraints.

Benefits Achieved:

This furniture is designed to save space while providing an organized and modern work environment. The design is flexible enough that work stations can be configured to fit the tasks being performed, thereby enhancing productivity. The furniture can be designed to accommodate automatic data processing equipment far better than previous "standard" items. The furniture ordered under this BDO can be reconfigured for future use. Using modular in lieu of standard furniture will save replacement costs when moves occur. Users will note such benefits as more efficient office space relative to function, increased air circulation, and improved temperature modulation.

Contact for more information:

Laura Simmons
202/453-1815

96. Personnel Office Automation

NASA Headquarters (Code DP)

Description of the Activity:

Code DP is implementing its multi-year program of fully automating the personnel operations of NASA Headquarters. Seventeen microcomputer stations now operate within the organization with an integrated package of software and access to the mainframe personnel data base.

Benefits Achieved:

This process has resulted in a significant improvement in word processing and other clerical operations, budget tracking, work force analysis, FTE management, and the analytic support of allied offices (including the Headquarters Budget Unit and client offices).

Contact for more information:

David Cushing
202/453-8588

97. Improved Program/Office Efficiency

NASA Headquarters (Code ES)

Description of the Activity:

MacIntosh II computers were recently installed in the Space Physics Division. Using the same type of computers has resulted in greater efficiency in maintaining program data while significantly reducing the amount of paperwork involved in the day-to-day program activities. Additionally, a local area network enables communication between computers within the Division. A network mechanism for obtaining information on other Division programs not in the user's respective area(s) is available to staff members with a need-to-know. The computers are programmed for printing through a Laserwriter that is centrally located within the Division.

Benefits Achieved:

The computer network has reduced paperwork while providing a method for maintaining program data. Use of the Laserwriter printer has eliminated the need to purchase individual printers for each computer, which has resulted in significant savings.

Contact for more information:

Tom Perry
202/453-1676

98. Technical Assistance Agreement

NASA Headquarters (Code GP)

Description of the Activity:

While researching ion thruster technology, Lewis Research Center inventors--Michael J. Mirtich, Bruce A. Banks, and James S. Sovey--developed a process for producing diamond-like carbon films on a substrate (U.S. Patent No. 4,490,229). Air Products and Chemicals, Inc., as part of an effort to diversify its product line, decided to form a business unit to coat substrates with diamond-like carbon films. After discussing the patent with the three NASA inventors, the company applied for an exclusive license. However, Air Products lacked the technical expertise to commercialize the invention in a short enough time period to enter the market prior to their competitors. Hence, Air Products requested that NASA allow the inventors to provide technical assistance to the company's technical personnel. NASA responded by developing a new type of Space Act agreement--a Technical Assistance Agreement, which allows Air Products to receive the assistance it needs.

Benefits Achieved:

The Technical Assistance Agreement allows NASA to license inventions that require technical assistance before the licensees can successfully practice and commercialize the inventions. It also allows licensees to commercialize inventions much faster than if technical assistance were not available.

The Technical Assistance Agreement also provides for the protection of commercially valuable data supplied by the licensee to NASA. This allows a licensee to disclose information in confidence to NASA so that agency employees can fully assess what assistance is needed. An additional benefit is that the agreement provides for the ownership of data and inventions that may be created under the agreement.

Contact for more information:

Harry Lupuloff
202/453-2420

99. Licensing an Aviation De-icer

NASA Headquarters (Code GP)

Description of the Activity:

In 1987, NASA/Ames engineers--Leonard A. Haslim and Robert D. Lee--invented a device for efficiently removing ice from airplanes. This device, entitled the Electro-Expulsive Separation System (U.S. Patent No. 4,690,353) was recognized by the patent staff of the NASA General Counsel's office as being one of NASA's most commercially important inventions. NASA originally proposed to license this invention to the B.F. Goodrich Company; but as a result of advertising the proposed license grant in the Federal Register, a number of other companies also desired a license. Due to the significance of the de-icer and the great commercial interest in it, a unique competitive bidding system was developed to license this invention. Licenses for this invention were awarded to Dataproducts New England, Inc., in November 1988.

Benefits Achieved:

The competitive bidding system can be used for any commercially significant invention in which more than one qualified company applies for a license. It is a fair and objective system for deciding which applicant will obtain a license. It uses license agreements in which all except a few key terms, such as royalties and commercialization periods, are fixed by NASA. The applicants bid by supplying the key terms, and each bid is ranked according to a formula. This system essentially allows the free market to determine: (1) the licensee, and (2) the royalties and commercialization periods.

Contact for more information:

Harry Lupuloff
202/453-2420

100. Acquisition and Use of ADP Equipment

NASA Headquarters (Code L)

Description of the Activity:

The Office of Communications obtained six new Macintosh computers during 1988 to increase productivity and creativity, and to decrease man-hours in performing tedious activities.

Benefits Achieved:

The Macintosh II computers were purchased and installed in the newsroom, internal communications, and collocated public affairs offices to provide desktop publishing,

graphics, and data management capabilities by Code L employees. Specific desktop publishing requirements for Code L include the production of Shuttle press kits, fact sheets on NASA projects, and the agencywide NASA Activities magazine.

Graphics requirements for the Office of Communication include internal use (such as meetings and planning activities) and external use (such as press conferences and public events). These computers allow for more flexibility and control over materials produced by the Office of Communications. The computers also have saved time by eliminating the need to submit work to an outside graphics artist.

Data management is a requirement in all Code L offices, especially in the collocated public affairs offices where Code L employees operate as essentially one-person operations, responsible for having quick access to large volumes of information. They also must have the ability to track the costs and status of various Office of Communication projects.

Contact for more information:

Edward Compion
202/453-8400

101. Training Opportunities

NASA Headquarters (Code M)

Description of the Activity:

In September 1988, the Resources Management Office sponsored in-house training open to all employees. Speakers participated in this training from within the Resources Management Office as well as from other Headquarters Codes, NASA centers, and organizations external to NASA. This training encompassed a broad spectrum of subjects, such as: (1) the 506 process, (2) procurement planning, and (3) other agency personnel initiatives.

Benefits Achieved:

Employees were enlightened on areas of interest both within and outside of their normal realm of duties. This effort motivated NASA employees to seek more detailed knowledge in a variety of subjects. This training was particularly helpful to new employees, and was useful as a refresher course for others.

Contact for more information:

Dorothy K. Loveless
202/453-2498

102. Delegation of Authority for Patent Licensing Appeals

NASA Headquarters (Code NB)

Description of the Activity:

Previously, patent licensing appeals were delegated from the Administrator to the Inventions and Contributions Board (ICB) Chairman on an ad hoc basis. Recently, this procedure was changed to allow general delegation for all patent licensing appeals.

Benefits Achieved:

The general delegation saves executive and administrative time. Also, it establishes the decisional authority and independence of the ICB Chairman in this area, which builds confidence in the system and discourages appellants from lobbying the Administrator.

Contact for more information:

Carroll Dicus, Jr.
202/453-2890

103. Boards of Contract Appeals Alternate Disputes Remedies

NASA Headquarters (Code NC)

Description of the Activity:

There is currently an emphasis on using settlement techniques that are known collectively as "Alternate Disputes Remedies" (ADR). Such techniques frequently require a settlement judge, who must normally disqualify himself or herself from the appeal. This is a problem for three-member boards of contract appeals (BCAs), because it takes agreement by at least two judges to decide most cases. Thus, if one judge is disqualified and the other two disagree, disposition is impossible. The solution was for the three-member BCAs to agree to exchange settlement judges. Such an agreement exists on an informal basis between the Energy, HUD, and NASA BCAs.

Benefits Achieved:

In an informal exchange with the Energy BCA, a NASA judge acted as the settlement judge; although the case did not settle, he was successful in narrowing the issues and facilitating disposition. In the future, NASA will similarly utilize other BCA judges. The increasing emphasis on ADR has made the process more amenable to accommodating innovative approaches.

Contact for more information:

Carroll Dicus, Jr.
202/453-2890

104. Revised Triennial Review Program

NASA Headquarters (Code NTD)

Description of the Activity:

The revised triennial review process meets or exceeds the General Services Administration requirements and satisfies the Headquarters requirement of more involvement in the review process. NASA has combined the best features from existing reviews, such as the Information Processing Management Reviews, the Data Processing Installation reviews, and the old triennial review process. The result is a single review on a 3-year cycle that will cover all aspects of Information Resources Management for the centers.

Benefits Achieved:

This approach has resulted in a tangible reduction in the centers' paperwork burden. Prior reviews were based entirely on subjective essay-type questions. The new reviews include increased Headquarters involvement, an objective questionnaire used to focus the review, and center visits with interviews. The net effect is a reduced number of reviews at the installations, and improved quality and usefulness of the reviews that are conducted.

Contact for more information:

J. Mike Machen
202/453-1980

105. Design/Build Method for Large Facility Construction

NASA Headquarters (Code NX)

Description of the Activity:

Construction of the \$17 million LC-39 Operations Support Building at Kennedy Space Center has been approved by NASA. This increase in building size will further relieve the severe housing problem at KSC. Code NX is directly supporting and participating in the use of the design/build procurement method to increase building size within the Congressionally appropriated \$17M budget by as much as 50 percent.

Benefits Achieved:

By combining the separate steps of architect-engineer selection, design, bid, and build into a single procurement, one contractor designed and is currently building the facility. This method apparently has assured compatibility between project design and construction teams to promote lower cost per square foot of building, thereby achieving a larger building for the same cost. It also places responsibility on the contractor for any design errors discovered during the construction phase. Currently, the goal of constructing a larger facility without an increase in budget cost has been achieved. The building area has been increased from 188,000 square feet to 297,000 square feet, an increase of nearly 60 percent.

At \$65 per square foot with design/build versus the comparable cost of over \$100 per square foot using the conventional method, this method will translate into a savings of over \$10 million.

Contact for more information:

Norman Willis
202/453-1982

106. Electronic File Transfer for Program Reviews

NASA Headquarters (Code S)

Description of the Activity:

The monthly Space Station Freedom Program Office (SSFPO) Review includes seven major contractors, five NASA centers, and three sets of international partners. To streamline information transfer of presentation material, a template was developed to allow electronic file transfer and storage of presentation material.

Benefits Achieved:

Electronic transfer has reduced paperwork, accelerated receipt of data, saved time by streamlining procedures, and standardized review formats.

Contact for more information:

Tyrone Taylor
703/487-7399

107. NASA Educational Workshops for Elementary School Teachers (NEWEST)

NASA Headquarters (Code XEE)

Description of the Activity:

NASA Educational Workshops for Elementary School Teachers (NEWEST) took place at four NASA centers during the summer of 1988. The NEWEST program is sponsored by NASA in conjunction with the National Science Teachers Association (NSTA) and the National Council of Teachers of Mathematics (NCTM). Twenty outstanding elementary school teachers were selected for each workshop. During the 9-day programs, the teachers explored the most recent developments in the areas of Space Station and interplanetary exploration. They learned how to access NASA educational materials and applications for aeronautics and space technology for the elementary curriculum.

Benefits Achieved:

The NEWEST workshops disseminates NASA information and educational materials into the elementary teaching community. In keeping with the Educational Affairs Division's long-range goals, this pilot program supports the educational priorities of elementary and teacher education, and fills a need in the elementary teaching community to learn of sources for information about aeronautics and space. It affords the teachers an opportunity to develop methods of implementation for their classrooms.

NEWEST was met with great enthusiasm by the educational community. The results were very encouraging, reflecting the elementary community's desire for NASA materials. The educators have taken this unique experience back to their classrooms and their colleagues. To meet the demand for additional workshops, this pilot has been implemented as a yearly program, and workshops are planned at five NASA centers during the summer of 1989.

Contact for more information:

Name: Eddy Anderson
Tel.: 202-453-8348

108. NASA Graduate Student Researchers Program

NASA Headquarters (Code XEU)

Description of the Activity:

The NASA Graduate Student Researchers Program provides 80 new graduate fellowships each year to post-baccalaureate U.S. citizens to conduct their thesis research or plan of study at a NASA center or a university. Fellows selected by a NASA center must spend

a period of time in residence at that center, taking advantage of the unique research facilities of the installation and working with center personnel. The program funds students for 3 years (300 students are supported each year).

Benefits Achieved:

The large number of training grants required by this program had resulted in processing delays. In cooperation with the NASA Contracts and Grants Division, Code XEU developed a staggered time schedule for grant processing. Also, two additional staff members were hired by the Contracts and Grants Division. The cooperation of all parties in adhering to the time schedules resulted in 350 grants being processed and sent to universities on time. For the first time in recent memory, there were no complaints from universities or students.

Contact for more information:

Elaine T. Schwartz
202/453-8344

IV. NEW TECHNOLOGY/MODERNIZATION

109. A Brassboard for AI Concept Development and Validation

Ames Research Center (ARC)

Description of the Activity:

The Systems Autonomy Demonstration Project (SADP) is efficient and productive in developing new Artificial Intelligence (AI) concepts and methodologies for real-time control of large complex systems. The SADP uses a Brassboard hardware replica at Ames of the JSC full-scale Space Station Freedom (SSF) Testbed.

Programming concepts developed by SADP include generic software "shells" such as Model Tool Kit (MTK) for modeling complex systems and Executive Tool Kit (XTK) for executive control of complex systems. In addition, real-time performance techniques developed and utilized by SADP include methodologies for compiling symbolic language rules and tasks to speed up the actual runtime computations.

Benefits Achieved:

Using an Ames Brassboard to develop and validate AI concepts prior to use of the JSC full-scale testbed is cost-efficient, because (SSF) testbeds have limited accessibility and are very expensive when used. The Brassboard is a much more efficient productivity tool.

Contact for more information:

John Bull
415/694-5966

110. Real-Time In-Flight Calculation of Aircraft Net Thrust

Ames Research Center (ARC)

Description of the Activity:

A real-time in-flight aircraft net thrust computation technique was developed for the General Electric F404-400 engine, based on the Computing Devices of Canada's Simplified Gross Thrust Method (SGTM). This algorithm was derived from a thrust calibration of the flight engine at LeRC, achieving an accuracy of +1.8 percent. The in-flight value was estimated to be in excess of +3 percent; and can be calculated in real-time for the aircraft at up to 12.5 times/second using a minicomputer, and a simple and efficient computer program.

Benefits Achieved:

This new technique enables direct, real-time inflight calculation of aircraft net thrust. The required instrumentation system is simple, robust, and low cost. The computation algorithm is simple and efficient with excellent accuracy compared to normal post-flight data reduction methods.

This technology lowers the cost of flight test and instrumentation; and gives a direct, immediate measure of actual engine thrust levels.

Contact for more information:

John W. Hicks
805/961-3301

111. Scientific and Technical Electronic Publishing System (STEPS)

Ames Research Center (ARC)

Description of the Activity:

In 1988, Ames implemented the basic STEPS system. The hardware configuration at the Dryden site consists of Mac II work stations for each technical typist and most of the graphics staff, a 600-dpi laser printer, a 300-dpi draft laser printer, an optical character reader, and a 300-dpi gray-scale scanner. Software being used includes MacTex, Pagemaker, MacDraw, and Adobe Illustrator. The work stations are electronically linked via a local area network, and to the user community through the data switch and the mainframe computer.

Benefits Achieved:

STEPS has eliminated virtually all rekeyboarding of research documentation. The author now creates a document online, then transfers it electronically to Manuscript Preparation where reviewers' comments are incorporated without rekeying the original text. This has resulted in a 40 percent increase in documentation produced in 1988 over 1987 production, with no increase in the Manuscript Preparation staff.

In addition, the documents produced on the new system are more professional in appearance. The improved appearance is especially evident in equations, where the availability of multiple type styles and sizes for the various alphanumeric characters and symbols allow typeset-quality output. The availability of online characters and fonts also has eliminated the need for manually-applied characters, which has reduced the time required for (and the number of errors introduced into) successive revisions.

Contact for more information:

Linda J. Quinby & Bertie Cox
408/961-3717

112. A Self-Calibration Method for TOMS Data Reprocessing

Goddard Space Flight Center (GSFC)

Description of the Activity:

GSFC personnel, with the support of STX Corporation, have developed a method for recalibrating the optics of the Total Ozone Mapping Spectrometer (TOMS) satellite instrument for its entire lifetime (1979 to the present). The TOMS instrument measures total ozone of the entire globe by determining the measured reduction of ultraviolet earth albedo by ozone absorption for several wavelength pair ratios. Unfortunately, the TOMS optics have been degrading with time after launch in a manner that is not known with adequate precision. Since the sensitivity to calibration errors was mainly to wavelength-dependent properties, the different wavelengths available were used to determine the time-dependent calibration curve. An independent check of this calibration is afforded by a second instrument, Solar Backscatter Ultraviolet (SBUV), that shares a portion of the optical path with TOMS.

Benefits Achieved:

By using an internal self-calibration method, it is now possible to reprocess the high spatial resolution total ozone data for the entire globe from 1979 to the present. This results in increased accuracy for determining the global rate of ozone decrease during the past decade, and the corresponding changes within latitude bands. This achievement brings the TOMS data set into agreement with the geographically sparse ground-based Dobson network, and other limited data sets. Future TOMS instruments are expected to be modified by incorporating an additional wavelength channel specifically to enhance the self-calibrating feature.

Contact for more information:

Dr. Robert Hudson
301/286-5485

113. FDF T-1 Line Installations

Goddard Space Flight Center (GSFC)

Description of the Activity:

In January 1988, the Flight Dynamics Division, Computer Systems Management Branch, consolidated all of its data communications to the primary Computer Sciences Corporation (CSC)/System Engineering and Analytical Support (SEAS) contractor site over two (primary and back-up) T-1 1.54 mega-bit-per-second (Mbps) communications links. The telephone company-supplied T-1 lines provided enough band-width to allow the CSC/SEAS contractors, located approximately 1-mile away, to communicate with the three GSFC Flight Dynamics Facility (FDF) mainframe computers at much higher data transfer rates and with more improved reliability than those used in the past history of the FDF.

Benefits Achieved:

The consolidation of GSFC data communications resulted in the following operational and productivity gains:

- For IBM 5080 graphics devices, the data access rate increased from 56 Kilo-bits-per-second (Kbps) to 256 Kbps, which is 4.6 times better than the previous throughput; an improvement of 457 percent.
- The new communication links provided the capability to support remote terminal users at increased data rates of 56 Kbps (as opposed to the prior 9.6 Kbps rates), without additional line costs; an improvement of approximately 6 times or 583 percent.
- A 99.8 percent line availability rating was achieved; this allowed the users more uninterrupted computer system access time, which resulted in an overall improvement of system programmer productivity at the remote work-place.

In addition, line-leasing costs to support these remote operations were decreased substantially from approximately \$7,500.00 per month to \$1,880.00 per month, which resulted in an improvement of approximately 400 percent.

Contact for more information:

Ellie Davoli
301/286-9395

114. Standard Balloon Designs for the NASA Scientific Balloon Program

Goddard Space Flight Center (GSFC)

Description of the Activity:

A new design philosophy for the NASA Balloon Program has been implemented. For the first time, "standard" balloon sizes and a single thickness material (0.8 mil) have been developed for use in the balloon program. Three balloon volumes - 12 million cubic feet (mcf), 23 mcf, and 28 mcf - have been established as standard NASA designs. Different performance requirements are accommodated through the addition and sizing of caps, while maintaining the original design shape.

Benefits Achieved:

Implementing a standard design for the NASA Balloon Program minimizes balloon design variables, and reduces fabrication time and cost. To date, 89 balloons have been flown with an overall success rate of 98 percent.

Contact for more information:

Harvey C. Needleman
301/286-1453

115. Water Usage System Upgrade

Goddard Space Flight Center (GSFC)

Description of the Activity:

In the Optical Thin Film Laboratory, there are presently four vacuum systems and one distillery plant in use. All of these systems utilize domestic water as a cooling medium. Once the water passes through the systems it is deposited into the sanitary waste system. The total combined water usage for the systems exceeds 7,760,000 gallons/year.

In addition to the water consumption problem, the use of domestic water in these types of systems requires the use of high density filters that must be replaced frequently. The frequency of filter changes is directly related to construction projects around the centers. When work is done that involves the main water supply to the building, the frequency of filter changes increases dramatically from once every few weeks to once every few days.

In response to a suggestion program idea, the Engineering Directorate decided to implement a closed-loop heat exchanging system to meet the equipment cooling needs of the Laboratory. A closed system would not use any domestic water or require the use of

the sanitary waste system. The installation of a closed-loop air cooled heat exchanging system utilizing a distilled water and glycol solution with a chilled water heat exchanger (for hot weather use) would completely isolate the lab's equipment cooling needs.

Benefits Achieved:

Based on current Washington Suburban Sanitation Commission (WSSC) water and sewer rates, if the facility were in total operation the savings would equate to approximately \$40,000. The nonrecurring cost for installing the cooling system described above is \$4,650.00, so a substantial cost savings will be realized immediately and in the future.

Contact for more information:

Linda Miner
301/286-8200

116. Voice Communications Management System for NASA Resident Office-JPL, Office of the Manager

Jet Propulsion Laboratory (JPL)

Description of the Activity:

A prototype Voice Communications Management (VCM) System was implemented in the Office of the Manager at the NASA Resident Office (NRO)-JPL. The network includes voice message capability to communicate with staff, on-line telephone books with automatic search, select, and dial capability; and an on-line calendar with alert function to schedule and track all appointments and reminders. The network includes a fileserver and three local and two remote workstations, which are linked through a local area network that will eventually allow additional workstations in the NRO and JPL to be included. Using a single-key entry to respond to voice prompts allows for quick and easy manipulation of all functions.

Benefits Achieved:

The VCM network was designed for easy use, with a single-key entry and voice prompts for most functions. Problems in communication of complicated and lengthy messages and appointment schedules have been eliminated. The network has proved to be reliable and convenient, and has greatly enhanced the productivity of the Manager's Office. Productivity will be improved further when the network is expanded to include more workstations, a capability to use distribution lists for messages, and dial-in functions.

Contact for more information:

Fred W. Bowen
408/792-5359

117. Improved Supply Tracking System

Johnson Space Center (JSC)

Description of the Activity:

The Supply and Materials Management Branch of the JSC Logistics Division has developed a software tool to track the course of a property requisition. This tracking tool functions as a subsystem to the Interactive Supply Management System (ISMS), which is evolving into a fully integrated, centerwide supply and materials management system. Requisitions are tracked beginning with placement of orders, to receipt and inspection of supplies and materials, throughout the paperwork processing stages, at product pick-up and delivery, and with final product receipt by the JSC customer.

Benefits Achieved:

The tracking system enhances the ISMS by providing JSC management with better visibility of materials flow, and quick identification of problem or bottleneck areas in the supply system. The system also automatically computes data required by Headquarters including: customer response time, backorder release status, physical inventory accuracy, location accuracy rate, and supply effectiveness rate.

The ISMS and tracking subsystem are now available for use by 26 on-site JSC contractors. A common supply management system for all contractors enables the center to better manage contractor operations. The potential benefits of this system are being reviewed by Headquarters as a possible model for agencywide utilization.

Contact for more information:

James Hickmon
713/483-6656

118. A New Sophisticated Computer Programming Language

Johnson Space Center (JSC)

Description of the Activity:

The C Language Integrated Production System (CLIPS) is a powerful computer programming language that provides a complete environment for the construction of rule-based expert systems. The language is the first of this type to provide a utility for verification and validation of expert systems development. CLIPS was created by the Artificial Intelligence (AI) section of the JSC Mission Planning and Analysis Division. CLIPS has been implemented at over 1,100 sites throughout the public and private

community including: all NASA sites and branches of the military, numerous federal bureaus, government contractors, 80 universities and many companies. A help-desk has been established at JSC to provide information and assistance regarding software capability.

Benefits Achieved:

As a NASA-developed language, CLIPS can be obtained without cost by NASA groups, other government agencies, and government contractors. Other user benefits include:

- Versatility as a software tool that can be run on conventional hardware, eliminating the need to purchase expensive hardware specifically tailored for AI applications.
- Ability to be integrated with conventional software (written in languages such as FORTRAN) so that the large body of existing code can take advantage of AI technology.
- Adaptability to be modified or tailored to meet specific programming needs (CLIPS contains its own source code).

These particular programming advantages also dramatically reduce costs required to investigate potential applications as well as train individuals in the use of AI technologies.

Contact for more information:

C. J. Culbert
713/483-8080

119. Space Bioreactor System

Johnson Space Center (JSC)

Description of the Activity:

The Space Bioreactor System, developed by scientists and engineers in the JSC Space and Life Sciences Biotechnology Program and Krug International, is a controlled culture system designed to maintain and grow mammalian tissue under both microgravity and unit gravity conditions. The total system provides an optimal physical and chemical environment allowing for precision control in culturing mammalian cells and tissues in orbital conditions. It is projected that the system's operation in microgravity will promote further enhancement of the fluid dynamic culture environment. Primary components of the semi-closed perfusion loop system are the media perfusion conduits, culture vessel, main loop pump, closed-loop gas exchanger, flow injection analyzer, computer process controller, and high molecular weight separation loop. The system is packaged for compatibility with both the Space Shuttle middeck area and the Biotechnology Facility of Space Station Freedom.

Benefits Achieved:

For the first time, large, three-dimensional "tissue-like" aggregates have been cultured outside of the body in single cultures (BHK cells) and co-cultures (fibroblasts and colon adenocarcinoma), producing tissue that appears similar to the identical tissue "in vivo." The NASA Space Bioreactor promises to advance basic understanding of biological processes. Potential uses in scientific research and biotechnology, and the pharmaceutical industry include:

- Research into the fundamental processes regulating development of organs and tissues.
- Control of normal and neoplastic tissue growth and factors controlling the invasion of normal tissue by cancerous cells.
- Use of biopsy cultures to test chemotherapy protocols to determine the most effective treatment for individual cancers.
- Expansion of cell and tissue use for transplantation.
- Isolation of growth or regulatory factors from interacting cell systems.

Such programs would be instrumental in developing new procedures and therapeutics to fight diseases, advancing new industrial processes involving cultured animal cells, and providing critical support to long-duration space missions.

Contact for more information:

Steve Gonda, Ph.D.
713/483-7146

120. Expanded Center Information Services

Johnson Space Center (JSC)

Description of the Activity:

Recently, the Media Services Branch of the JSC Public Affairs Office developed and initiated two new services to improve internal and external center communications:

1. A recorded telephone information service for NASA and contractor employees provides daily updates on information pertaining to the Space Shuttle, Space Station Freedom (SSF), and other NASA programs; international space-related news; NASA-related government news; and notice of JSC activities and coming events.

Staff from JSC and its support contractor, Media Services Corporation, worked together to identify, test, and procure a digital record-playback machine that is able to accept 10 calls simultaneously.

2. An electronic news service "bulletin board" provides 24-hour access by reporters and aerospace public affairs professionals. This electronic system consists of an AT-style personal computer, public domain bulletin board software, and two JSC telephone lines. Over 1,200 files have been loaded into the bulletin board, including NASA press releases, biographies, flight manifests, press kits, media guides, Space News Roundup (weekly JSC newspaper) stories, and other informational materials.

Benefits Achieved:

Expanding JSC's informational base to share access to newsworthy items both internally and externally, contributes to the center's ongoing effort to improve communications, and promotes its two-fold objective: a better-informed work force through increased employee awareness of center/agency activities and objectives, and a more educated constituency through greater understanding of the center's mission and operations.

The 24-hour access to the news service is an important tool that assists reporters and researchers in making timely and accurate observations relating to manned space program activities.

Contact for more information:

Steve Nesbitt
713/483-5111

121. On-Line Centerwide Financial Management System

Johnson Space Center (JSC)

Description of the Activity:

JSC's Financial Management Division recently designed and implemented the Interactive Consolidated Financial Accounts System (ICFAS)--a fully automated centerwide financial management system, which encompasses all stages of budget execution, from program authorization to fund disbursement. The ICFAS includes the following three elements (core JSC detailed financial data):

1. Active fiscal accounts, reflecting every fund account controlling all program and institutional activities emanating from the center. (Inactive accounts are also represented on a resource authorization file, which presents a history of its cumulative fiscal status at the time the account closed for auditing purposes.)

2. Travel files that display detailed financial information on individual travel performance data.
3. Reference tables that provide control and cross-reference information for the system.

The system houses the data in the Center Information Network on the IBM mainframe and utilizes the Nomad 2 application programming language.

Benefits Achieved:

Prior to June 1988, all records pertaining to fiscal accountability had to be accessed through a "batch" computer system, which is a relatively slow and cumbersome system whereby computer output is produced in the form of multiple listings of data and distributed manually. Batch reports tend to dump large portions of the accounting data base to the user, who must then sort the data by hand to find pertinent information.

The ICFAS is a totally integrated, consolidated, real-time data base that reflects the status of every financial account, and enables managers, financial and budget analysts, and other administrative personnel to obtain a complete picture of program financial performance. Users can input, review, extract, and manipulate financial information pertaining to every stage of fund accounts, purchase requests, contracts, and travel authorizations. The increased timeliness and flexibility of this system also promotes more effective methods of budget planning and analysis in meeting fiscal year cost projections.

Contact for more information:

Patrick Kidwell
713/483-4845

122. Software to Improve Detection of Orbital Debris

Johnson Space Center (JSC)

Description of the Activity:

The Interactive Image Registration and Celestial Location Software was created by Lockheed engineers and scientists at the JSC Video Data Analysis System Laboratory to assist astronomers in analyzing video data for the presence of orbital debris. Previously, astronomers manually plotted celestial locations to gather information pertaining to orbital debris detection. By allowing the operator to automatically determine the celestial pointing information for any area in the sky, this software provides an interactive, near-real-time image registration for collecting video data to support orbital debris studies. The software works in conjunction with a telescopic hardware tool known as a geometric warper, and is compatible with two important telescopes currently being used by JSC astronomers: the Lenzar telescope, which is onsite at the Planetary and Earth Sciences Laboratory; and the Socorro telescope, which is located in New Mexico.

Benefits Achieved:

With the growing presence of debris in low-earth orbit and the possible threat it poses to U.S. spacecraft, it is critical that technological advances such as this software be made to enhance observation techniques in detecting orbital objects. As a result of this newly developed software, tasks that formerly consumed a considerable amount of operator effort and had been prone to operator subjectivity, are now performed automatically and with greater precision. This has increased productivity by approximately 5,900 man-hours per year. More importantly, this software has enabled the center's Orbital Debris Project to effectively utilize video data from the Lenzar and Socorro telescopes.

Contact for more information:

Clyde A. Sapp (Lockheed Engineering and Sciences Company)
713/483-5141

123. Technical and Management Information System (TMIS)

Johnson Space Center (JSC)

Description of the Activity:

The first increment of TMIS at the JSC Space Station Projects Office (SSPO) was implemented by Boeing in early 1988. TMIS provides SSPO with 45 Apollo workstations for engineering and documentation, as well as 43 administration workstations loaded with TMIS-provided software. It also includes 30 laser printers and 40 dot matrix printers, as well as E-size scanners and plotters supporting the workstations. The JSC SSPO equipment is on a local area network, which connects all NASA centers to the TMIS host computers. Boeing provided an offsite facility for staging equipment and training. Currently, a TMIS help-desk is functioning onsite for user support.

Benefits Achieved:

The TMIS equips SSPO personnel with state-of-the-art tools to perform everyday functions. For example, electronic mail has replaced telephonic communications and memoranda in transmitting technical and administrative information to individuals working on the Space Station Freedom Program (SSFP). The standardized TMIS hardware and software networking system also allows for the data sharing by program and projects office personnel. Further, the system permits electronic transmission of compound documents (integrated text and graphics) and data from JSC to the SSFP Office in Reston, Virginia; and between JSC and the other SSFP workpackage centers. This eliminates the time-consuming and burdensome process of creating, reproducing, packaging, and shipping bulky hard-copy documents. Finally, the Interleaf documentation system, with its capability to electronically

integrate text and graphics, has produced considerable manpower and time savings by alleviating the need to separately create graphics and cut/paste them into textual documents.

Contact for more information:

Boyd Jackson
713/483-0004

124. Computer Evaluation of Step and Gap Data/Laser Step and Gap Tool

Kennedy Space Center (KSC)

Description of the Activity:

Initial implementation of computerized evaluation of tile Step and Gap (S & G) data occurred during final preparation of the OV-103 Return-to-Flight Mission. The S & G data are input into the computer where the evaluation of each measurement is performed, with an output of the recommended rework for each given situation. Prior to implementation of this method, each S & G that was performed required manual Technician, Quality Control, and NASA evaluation.

The system is designed to incorporate the Laser S & G Tool, which provides for automatic data entry. In this process, a tool is placed over the area requiring measurement by the Technician, and a laser beam then takes the measurement of the tile-to-tile S & G for that location. This information is then automatically input to the computer for data evaluation.

Benefits Achieved:

Computer evaluation of S & G data and use of the laser S & G tool provide a man-hour savings of approximately 1.5 hours per tile. Based on 2,739 tile installations in 1988 that required S & G, this equates to approximately 4,100 man-hours per year. These estimates are for tile removal and replacement only and do not include the numerous S & G performed during Carrier Panel or Landing Gear Door Work.

This method provides more accurate and consistent evaluation of data. The manual method could only be done by the Tech taking separate measurements and attempting to take them in the same location. The laser S & G tool is much more accurate because it takes S & G measurements simultaneously at the same location.

Contact for more information:

E. A. Muldowney (Lockheed Space Operations Company)
407/867-5385



The technician on the right is taking measurements using the Laser S & G tool. The technician on the left is using the old method with feeler gauges.

125. COBE Communications Upgrade at Space Launch Complex-2

Kennedy Space Center (KSC)

Description of the Activity:

The decision to launch the Cosmic Background Explorer (COBE) payload from a Delta rather than the Shuttle at Vandenberg Air Force Base necessitated a review of the inactive communications system at the Space Launch Complex-2 (SLC-2). The review of the condition of this system indicated that it would be very expensive to restore to its earlier operational capability, and would have less capability than is desired today to process the vehicle.

By using Transistorized Operational Phone System (TOPS) equipment that was in storage at Cape Canaveral Air Force Station (CCAFS), and using Air Force personnel to do the major installation work, a new high quality and far more capable system was inexpensively completed in time for pad revalidation and operations.

Benefits Achieved:

The productivity of the limited number of personnel available for accomplishing the work on SLC-2 will be enhanced through greater flexibility and higher reliability of the communications system.

Contact for more information:

John R. Zeman
407/853-9353



John Zeman, of the Radio Frequency and Telemetry Branch, Expendable Launch Vehicles, is responsible for the Communications Systems at SLC-2 at Vandenberg Air Force Base, CA.

126. Computer Codes for High Speed Chemically Reacting Flows

Langley Research Center (LaRC)

Description of the Activity:

Computer codes have been developed to model details of supersonic reacting flows. These codes solve 2-D and 3-D Navier-Stokes or parabolized Navier-Stokes and species continuity equations governing multicomponent chemically reacting flows using either finite-difference or spectral numerical methods. The codes, which are modular in structure and have very generalized finite-rate or equilibrium chemistry models, have been validated against experiments involving both nonreacting and reacting flow fields. Currently, the codes include an H_2 -air reaction system.

Benefits Achieved:

Since their development, the codes have been used for studying reacting flow through scramjet combustors. Also, they are being used in basic studies such as mixing and combustion enhancement in reacting supersonic shear layers. The codes have been made available to industries and universities, and are widely in use.

Contact for more information:

J. Philip Drummond
804/864-2298

127. Advanced Capability for Coordinate Measurements

Langley Research Center (LaRC)

Description of the Activity:

The Coordinate Measuring System has been updated in anticipation of the influx of numerous parts and assemblies developed for large space structures. The most recent hardware is augmented by computer compensation software to achieve the greatest possible measurement accuracy. Support software packages enable the Quality Assurance (QA) Specialists to custom-design inspection programs for large space structure hardware. Highly motivated QA Specialists have designed intricate operational programs that challenge the limits of the manufacturers' support software.

Benefits Achieved:

Critical, space-flight hardware can be measured with more than twice the accuracy of previous methods. The tens-of-thousands of measurements are made in less than 5 percent of the time for previous measurements. The equipment can operate 24 hours a day with QA Specialists working only two shifts of 8 to 10 hours. Therefore, a previously impossible hardware inspection schedule will be met, and data will be transmitted through a distributive computer network in a format readily useable by researchers. This system will save approximately 5 man-years annually, for a cost savings of approximately \$150,000 per year.

Contact for more information:

Roland W. Lee
804/864-4566

128. Pressure Visualization (PreViz) Package

Langley Research Center (LaRC)

Description of the Activity:

The Pressure Visualization (PreViz) package is a set of computer programs that transform aerodynamic experimental results into a graphic display of the test aircraft with coefficient of pressure (C_p) readings shown as displacement vectors at the pressure port locations. This package is being used at the NASA Langley 20-foot spin tunnel to help analyze test results obtained from the Royal Australian Air Force (RAAF) trainer aircraft. Two additional groups, one studying wing loading on the F-18, the other analyzing pressure data from the F-106B vortex flap flight test program, have an immediate need for this capability.

Benefits Achieved:

The PreViz package provides a new capability that is already in demand. Of particular interest is the ability to graphically display the magnitude of pressure, a vital feature when comparing results from many different tests. The resulting graphic images allow the research engineer to review vast amounts of test results in a fraction of the time needed to review the equivalent volume of tabulated listings. The time saved then may be used to perform a more detailed analysis and/or conduct more tests. This capability may be help in identifying and investigating test anomalies.

Although designed for displaying pressure data, the PreViz package can easily accommodate other surface properties, such as structural loading, temperature, skin friction, or mass flux.

Contact for more information:

Bradford Bingel (Computer Sciences Corporation)
804/865-1725

129. Water Triple Point Maintenance Bath

Langley Research Center (LaRC)

Description of the Activity:

The triple point (T_p) of water, 0.01 C by definition, is the most fundamental fixed point in thermometry and a defining point on the International Practical Temperature Scale (IPTS). The most important use of the T_p cell is in assuring the calibrations of standard platinum resistance thermometers (SPRTs), which are used as interpolating instruments for realizing the IPTs. The freezing of a T_p cell is tedious and time-consuming because the process involves the controlled growth of an ice mantel inside a fragile glass enclosure. Once frozen the cell is rarely usable for more than a few hours. A relatively inexpensive

device was developed using the small freezer, which maintains a triple point cell for 3 months or longer.

Benefits Achieved:

This apparatus provides long-term maintenance of a triple point cell, which allows the standard platinum resistance thermometer to be calibrated before each use as a reference standard. This provides greater reliability and improves the uncertainty in thermal sensor calibrations at Langley. In addition, this apparatus results in a net savings in time to LaRC of about 10 man-hours per week. This also reduces the frequency of expensive recertifications by the National Institute of Science and Technology.

Contact for more information:

James West (Wyle Laboratories)
804/865-0000

130. Optical Disk System for Archiving Satellite Data

Langley Research Center (LaRC)

Description of the Activity:

An optical disk system is being used to store and distribute archival data from the Earth Radiation Budget Experiment (ERBE), which is a three-satellite experiment designed to monitor the Earth's radiation budget. The first and second satellites were launched in 1984 and the third in 1986. The data from the instruments on these satellite experiments are reduced into science data products at Langley. The products then are archived for use by the scientific community following validation by the ERBE Science Team.

Benefits Achieved:

An optical disk system is now being used to distribute the ERBE data to the science team members. One month of ERBE data can be stored on a single optical disk, which is considerably more compact than the 120 magnetic tapes previously used for data storage. Each 12-inch diameter "write-once, read-many" optical disks stores 1 gigabyte of digital data on each side. Optical disks have an expected lifetime of 10 years with no maintenance requirement, whereas magnetic tapes have to be retensioned and copied to new tapes every 2 years. This archival and distribution technique should substantially reduce the cost and logistic problems associated with the distribution of large volumes of satellite data.

Contact for more information:

Michelle T. Ferebee
804/864-5617

131. Transport Systems Research Vehicle Systems Enhancement

Langley Research Center (LaRC)

Description of the Activity:

The ATOPS Program Transport Systems Research Vehicle (TSRV) has been upgraded with several enhancements. A sidearm/hand controller (SAC) system has been installed in the Research Flight Deck to replace the original panel-mounted controller on the pilot's side. New control display units (CDUs) have been implemented to replace the original units. A PC-AT IBM computer, containing an Artificial Intelligence (AI) Architects Hummingboard, has been interfaced to the experimental systems. This system will permit AI experiments in real-time. Finally, a Microvax II computer has been implemented on the TSRV. It is integrated into the total system and greatly enhances the computational capability of the system. With 32-bit word size and 9 megabytes of memory, it has twice the speed and 36 times the memory of the existing NORDEN PDP 11/70M computers. The flight software for flight control, navigation, and guidance has been recoded for this machine. Flight verification of the new implementations is scheduled for April 1989.

Benefits Achieved:

These additions to the TSRV greatly enhance the experimental capability of the vehicle. The SAC is a tool that permits a much improved method of aircraft control during experimental flight tests. The CDU can be employed over a broad latitude of experimental uses. It is also constructed of present day technology, thus providing vastly improved reliability.

The hummingboard implementation is the first of its kind in a transport aircraft. It will permit the first era of experimental study using rule-based programming in a real-time aircraft environment. Implementation of the Microvax dramatically increases the experiment support capability of the TSRV. It is expected to also increase the flight experiment throughput by a factor in excess of three, which is highly significant.

Contact for more information:

Gilbert A. Haynes
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132. New Fabrication Technologies

Lewis Research Center (LeRC)

Description of the Activity:

Through an innovative application of technology, a K1C machine, designed to burn rough starter holes very rapidly, is being used to burn small, accurate instrumentation holes through a thick piece of metal. The machine burns without ever touching the steel. A dielectric fluid comes through a hollow tubular copper electrode, like a straw, to cut the steel.

A new, multi-axis electrical discharge machine (EDM) replaces a conventional EDM that only had the ability to operate in one direction and reproduce the form of an electrode according to the form put in the machine. The new EDM is computer-programmed, so that many cuts can be made without designing complex electrodes. The multi-axis EDM can make continuous cuts in multiple, simultaneous directions.

Integration of Computer-Aided Design (CAD), Engineering (CAE), and Manufacturing (CAM) was vigorously pursued in 1988. Accomplishments include direct transfer of CAD graphic models to the CAE PATRAN program using International Graphical Exchange Specifications (IGES), and production of experimental turboprop blades with computer-controlled machine tools via a direct computer link with the CAD system.

Benefits Achieved:

Burning a small hole (.020 inch) through a 1-inch thick piece of stainless steel previously took hours to accomplish because the machine had to be rechecked several times throughout the drilling process. The new K1C machine can do the job in approximately 30 seconds.

The new EDM machine reduces the need to design complex electrodes, and accomplishes cuts faster with less work. The new machine also provides a better finish than its predecessor.

The integrated system of direct electronic transfer of information and data between CAD, CAE, and CAM takes full advantage of the improved productivity potential of these computer tools. Such a system eliminates the time-consuming and error-prone manual manipulation of data.

Contact for more information:

Jim Bergstrom
216/433-3009



Kenneth Guinta, a model maker at Lewis, positions an electrode prior to cutting a rotor on the new computer-controlled EDM. This machine reduces set up work, and provides for faster cutting and improved product quality.

133. Research Facility Modernization

Lewis Research Center (LeRC)

Description of the Activity:

Modernization of research facilities is critical for Lewis to remain at the leading edge of research and technology. Examples of improvements made through modernization of these facilities include:

- Installation of a state-of-the-art Distributed Control system and new solid-state fan motor drive controls in the Icing Research Tunnel. This new technology includes CRT displays showing visual representation of facility systems and their operational status, as well as display of real-time data.

- Modernization and enhancement of the existing impact test facility in the Structures Division. This enables researchers to quickly and efficiently evaluate the performance of advanced materials under impact-loading conditions that simulate the in-service operating conditions the components are exposed to. This is critical because enhanced component durability and increased performance life can be achieved if the impact resistance of the materials used in these components can be improved.

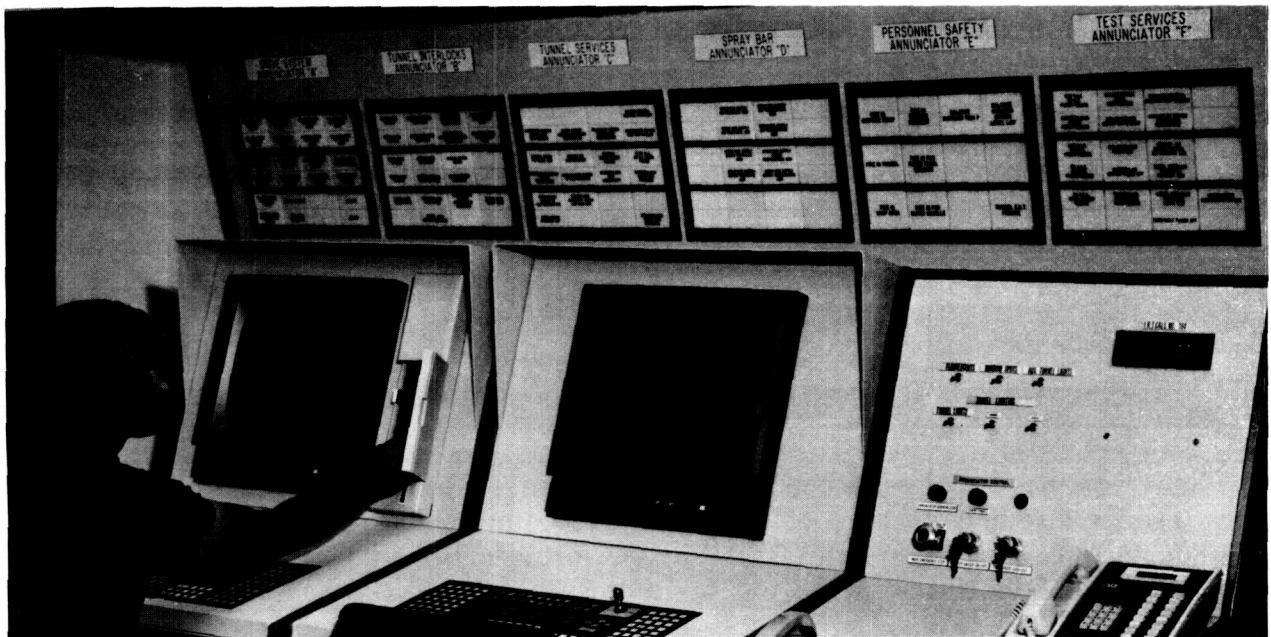
Benefits Achieved:

The new systems in the Icing Research Tunnel have helped Lewis accommodate the increasing demand from researchers for testing de-icing devices from outside manufacturers. A greater number of test points at a more precise setting can now be accommodated. The motor fan controls provide more effective speed (wind velocity) control. Also, the system is ergonomically designed to minimize operator fatigue.

Candidate new materials for use in aerospace components can be quickly and efficiently evaluated using the new experimental impact monitoring system. The computerized data acquisition, test monitoring, and instrument control facility represents a breakthrough in efficiency for measuring the dynamic behavior of new materials under impact loading.

Contact for more information:

David J. Steigman
216/433-2914



David Justavick of the Test Installations Division at Lewis operates the new Distributed Control System of the Icing Research Tunnel. The new system allows for a greater number of test points at more precise settings.

134. Computerized Document Description Library

Marshall Space Flight Center (MSFC)

Description of the Activity:

A computerized document library has been established that significantly reduces the time required to retrieve data from past Program Development studies. The Program Development Document Library (PDDL) was the primary project for the Program Development NASA Employee Team (NET) during 1988. Team members developed program software, collected document descriptions, and input the data into the directorate VAX computer. This easy-to-use, menu-driven program enables the user to quickly locate a document, or scan the entire library for document subjects. Each document description includes general information and an abstract. The general information consists of the document title, type of study, contract information or in-house study leader, study start and end dates, and a point of contact for obtaining a hard copy. There is also a list of "key words" that specify the major subjects that are addressed in the document. The abstract is a one- or two-page document description. A list of study participants is included for in-house studies, allowing users to find particular sources for information quickly. There are currently 300 document descriptions in the PDDL. As the size of the library increases, it will become an even more useful tool to Program Development personnel.

Benefits Achieved:

It is estimated that the PDDL will save over \$150,000 per year, as well as save information that otherwise might be discarded.

Contact for more information:

Jim McCarter
205/544-0536

135. Flight Robotics Facility

Marshall Space Flight Center (MSFC)

Description of the Activity:

A Flight Robotics Facility has been developed to support future NASA missions involving the rendezvous and docking of spacecraft; and the robotic servicing, assembly, and maintenance of orbital systems. Available for use by both industrial and NASA organizations, the facility contains two orbital mobility simulators capable of carrying full-scale spacecraft mockups and robotic manipulators for development and test of both automated and teleoperated satellite servicing systems. The facility supports realistic orbital lighting conditions, time delay, and video communications constraints. It has supported contractor-sponsored testing of contact dynamics, using a frictionless airbearing-supported

orbital mobility simulator, automated rendezvous and docking utilizing an eight degree-of-freedom overhead orbital mobility simulator, and automated satellite servicing by exchanging five configurations of orbital replacement units. MSFC-sponsored tests include automated rendezvous and docking using the frictionless orbital mobility simulator, camera and lighting studies related to rendezvous and docking in support of the Orbital Maneuvering Vehicle (OMV) program, and teleoperated robotic servicing in support of the Space Station program.

Benefits Achieved:

These facilities have helped to identify many technical issues associated with orbital manipulation and have encouraged wide-scale participation by both NASA and industry. Near-term programs benefiting from this facility are the OMV and the Space Station.

Contact for more information:

Frank Nola
205/544-3508

136. Program Logic Control for the Space Station

Marshall Space Flight Center (MSFC)

Description of the Activity:

An experimental version of the Space Station Environmental Control and Life Support System (ECLSS) is installed in a full-scale Space Station core module simulator and performs all of the functions required to support life in a space environment. Automating the processes in this module externally includes the control of approximately 125 solenoid valves; power switching of 8 subsystems; and the conditioning, displaying, and recording of the approximately 256 analog measurements. This control and data acquisition system performs pretest operations and facility setups, and properly aligns systems valves. The control system sequentially powers all subsystems, monitors and controls the system during long-duration testing, properly deactivates the subsystems, and fail safes specific critical valves in case of emergency shutdowns. A similar ECLSS test conducted in 1987 used manual control techniques, requiring continuous manual control of all system functions.

Benefits Achieved:

The present system allows single operator control of the entire test, which reduces overtime and provides for safer facility operations. It is conservatively estimated that over \$100,000 has been saved by using this system in place of the manual techniques.

Contact for more information:

Ellsworth Richter
205/544-1382

137. Drawing Conversion Process

Marshall Space Flight Center (MSFC)

Description of the Activity:

The Drafting Department of the Program Support Communications (PSC) Contract is using an electronic scanning service to digitize and convert older hand-drawn engineering drawings into Computer-Aided Design (CAD) files. The files then are imported into the CAD system, edited, updated and arranged into MSFC standard drawing formats.

Benefits Achieved:

Use of this conversion technique has reduced the labor required to update drawings. Initially, 413 drawings were converted with an estimated savings of 2.1 man-years. The conversion process is being enhanced, which will further decrease the editing process of the scanned drawings.

Contact for more information:

Guy Davis
205/544-6753

138. Simulation Tool for Automation and Robotics (STAR)

NASA Headquarters (Code C)

Description of the Activity:

The Center for Space Automation and Robotics, a NASA Center for Commercial Development of Space, has developed the STAR. The STAR is an off-line robotics programming environment that can be used by mechanism and robotic system designers to specify and simulate machine motion. STAR provides the necessary kinematic and dynamic modeling capabilities to take into account microgravity and other effects, and to manipulate design concepts on the screen to determine problems with interference, range-of-motion, or actuator performance.

Benefits Achieved:

Simulation is essential in the design of automated equipment for application in space. Computer simulation presents a powerful method for remote manipulator motion specification and analysis, allowing a "try-before-you-buy" approach to determine whether a manipulator is capable of performing required tasks.

Contact for more information:

Richard Ott
202/453-2121

139. Three-Fingered Dexterous Slave Hand

NASA Headquarters (Code C)

Description of the Activity:

At the Center for Space Automation and Robotics, a three-fingered (two fingers and a thumb) dexterous slave hand has been developed, featuring power and speed similar to the human hand. The hand is driven by self-contained actuators in a single mechanical module. It has the capability of operating in teleoperation modes with reflected force, minimal size and weight, and simplicity and robustness suitable for space and commercial use.

Benefits Achieved:

Improvements in dexterity will provide the capability to perform tasks not otherwise possible, and will significantly reduce the need for spacecraft design limitations that accommodate servicing robot performance limitations. Advanced teleoperated systems extend human manipulation, sensing, and cognitive capabilities to remote locations; thereby shielding the operator from the hazards of working in the task environment.

Contact for more information:

Richard Ott
202/453-2121

140. Four-Degree of Freedom Fingertip Sensor

NASA Headquarters (Code C)

Description of the Activity:

At the Center for Space Automation and Robotics, a low-cost compliant fingertip sensor has been developed for use in robotic grippers where force and torque feedback information is needed.

Benefits Achieved:

Integration of this fingertip on dexterous hands will allow the acquisition of sensitive force feedback from the slave robots in teleoperated systems and enhance telepresence. Eventually, the sensor will allow a teleoperated robot to grasp fragile objects and do delicate work.

Contact for more information:

Richard Ott
202/453-2121

141. Design of Lunar Miner to Recover Solar Wind Volatiles

NASA Headquarters (Code C)

Description of the Activity:

At the Center for Space Automation and Robotics, a remotely controlled, roving mining vehicle has been designed to recover valuable solar wind volatiles for use on the Moon or for export. The main objective of the miner is to recover valuable fusion fuel.

Benefits Achieved:

The He-3 fusion fuel can be used to generate energy in fusion reactors on Earth or in space. This fusion reaction with deuterium results in enormous amounts of energy released in a safe manner with minimal environmental effects. There is 10 times more energy in the He-3 on the Moon than in all of the economically recoverable fossil fuels on Earth. Only 20 tonnes of He-3 would be needed to provide the entire electrical energy used in the U.S. in 1988. The value of He-3 on Earth is on the order of \$1 billion per tonne and, at that price, the energy contained in He-3 is equivalent to oil at \$7.00 a barrel. The byproducts of the mining also will be of great value in supporting lunar settlements in the 21st century.

Contact for more information:

Richard Ott
202/453-2121

142. Conceptual Design of Space Flight Facility for Ultravacuum Thin-Film Growth

NASA Headquarters (Code C)

Description of the Activity:

At the Space Vacuum Epitaxy Center, a NASA Center for Commercial Development of Space, design parameters have been generated for a space flight facility (wake shield) that would generate an ultravacuum environment and have the capability of controlled epitaxial thin-film growth.

Benefits Achieved:

The flight facility will allow for critical proof-of-concept experiments in the space ultravacuum. The thin films that would be grown are expected to have far superior properties and be available in larger quantities than terrestrial materials, and are expected to open new arenas in semiconductor and superconductor device science and technology.

Contact for more information:

Mr. Richard Ott
202/453-2121

143. Full Implementation of Mishap Reporting and Corrective Action System (MR/CAS)

NASA Headquarters (Code QS)

Description of the Activity:

The Mishap Reporting and Corrective Action System (MR/CAS) is a fully automated collection and retrieval system for data generated from mishaps and close calls. The software, developed by Ebon Research Systems at Kennedy Space Center, is used by all NASA field installations and the Headquarters Safety Office (Code DB), and the Jet Propulsion Laboratory. Information about mishaps and close calls is entered into the system by each facility's safety office and transmitted electronically to the NASA Headquarters Safety Division (Code QS), which is responsible for maintaining the agencywide MR/CAS data base. All facilities came on-line in 1988. System capabilities include refined searches, graphics, a variety of report formats, and a module for tracking the implementation of corrective measures through to completion.

Benefits Achieved:

The MR/CAS eliminates the need for field installations to submit numerous forms to the Headquarters Safety Division; all reporting to Headquarters is done electronically. The system provides safety personnel in the field with a near-real-time status of their respective safety programs. Analyses of accident and close-call trends allow safety managers to implement corrective measures before serious accidents occur.

Contact for more information:

Linda Methia
202/453-8910

144. Automated Resources System

NASA Headquarters (Code R)

Description of the Activity:

The Office of Aeronautics and Space Technology has continued to make evolutionary enhancements to their Automated Resources System, which became operational in 1987. The system uses a relational data base, which enables a multitude of users to access the data base and array either tabular or graphic displays for resources management purposes.

Benefits Achieved:

The latest enhancement, which was completed in 1988, provides the capability to electronically generate reimbursable resources authority warrants. The data base contains specific information such as financial codes, previous balances, customer identification codes, and reimbursable agreement numbers. This data base allows the warrants to be generated by just entering those data elements that are new or changed with each issuance of authority.

The output is produced by a laser printer that generates the form as well as the resources information. In addition, the system produces various summary reports required in the management of reimbursable resources. This enhancement has reduced the support time associated with producing these documents and has improved the quality control as a spinoff benefit.

Contact for more information:

Edmund L. Sanchez
202/453-2790

145. System Design Tradeoff Model (SDTM)

NASA Headquarters (Code S)

Description of the Activity:

Space Station Freedom is being designed, built, and assembled over a 10-year period. It will accommodate a variety of end-to-end systems. The SDTM is a microcomputer-based tool, with an advanced user interface, which supports system-level cost and performance trade studies. The computer program allows the user to edit all system description formulas and parameters, and supports detailed comparisons of any two user-defined station designs in both cost and performance dimensions. It also includes a model of station operations and operations costs.

Benefits Achieved:

SDTM provides a complete data base of projected costs and performance, and is currently being applied to analyze cost and performance trade-offs for station design issues. This tool streamlines technical evaluation and cost comparisons in station design. This makes station design more efficient and less costly.

Contact for more information:

Richard Laeser
703/487-7200

146. Automated Requirements Management System (ARMS)

NASA Headquarters (Code S)

Description of the Activity:

The Space Station Freedom Program is a large, complex program with multiple requirements and interfaces. Work by seven major contractors, hundreds of subcontractors, five NASA centers, and the Program Office is performed under program requirements. The ARMS is an automated compilation of program- and system-level requirements and the linkages between them for program design, development, and test activities.

Benefits Achieved:

ARMS automatically indicates where requirements are derived or not properly derived, duplicated, ambiguous, or not addressed. The multiple views of the data set allow many diverse users to access the information and, therefore, eliminates the requirement for multiple documents. This results in productivity benefits and cost savings.

Contact for more information:

Richard Laeser
703/487-7200

147. Improved Graphics and Office Automation Resources

NASA Headquarters (Code TC)

Description of the Activity:

The Office of Space Operations in conjunction with General Sciences Corporation and MITRE Corporation have improved their graphics and office automation resources through the use of state-of-the-art computer equipment. The computer graphics specialist team uses a Macintosh II, Tektronix Color Printer, and Sharp Image Scanner to produce graphics with a professional image and format.

Benefits Achieved:

The improve graphics and office automation procedures have resulted in the following benefits:

- Clerical support staff has been relieved of the responsibility of designing and producing creative graphics for presentations.
- Dependency on outside printing and graphics shops has been minimized because "in-house" production has become easily accessible.
- Production and turnaround time have been reduced by 50 percent using the new equipment.
- Computer-generated graphics produce higher quality presentations than earlier methods.
- Internal communication and external outreach programs have improved through creative use of software and hardware capabilities.

Contact for more information:

Carla Clemens
202/453-5497

148. Computerized Exchange for Management Information

NASA Headquarters (Code TN)

Description of the Activity:

Computers are now being used to transfer formatted information between JPL and NASA Headquarters, Code TN. The facility is used to send graphics and Management Information System (MIS) data by computer-to-computer transfer between JPL and Headquarters. As a result, high quality presentation material and management data can be transmitted and, in a matter of minutes, edited as necessary at Headquarters or JPL. The transfer system currently uses a 9600-baud dial-up modem link (being updated to a 56Kb link) between JPL and Headquarters. This direct line between computers can be shared by all computers in either the JPL or Code TN network. In conjunction with the Videoconferencing Facility, this provides a powerful tool for maintaining and presenting up-to-date information necessary for day-to-day and long-range planning.

The timely transfer of computerized information facilitates the decision-making process at NASA Headquarters.

Benefits Achieved:

Several MIS data bases are now available to Headquarters via the electronic link. Among the most important are:

- **Budget data** - JPL's Work Authorization Document (WAD) is transmitted to Code T via the Macintosh, enabling a rapid dissemination of budget change and status information. The budget iteration process is expedited considerably by enabling two-way status and change information to be updated essentially instantly.
- **Task implementation milestones and status** - The TDA Office maintains a comprehensive document (890-191) detailing task status and implementation milestones for the Deep Space Network (DSN) Implementation and Engineering programs. This information is now available to Code T on-line.

This is the first step in a plan to network computers in the TDA Office at JPL and Headquarters, Code T.

Contact for more information:

Robert Holzman
202/453-1808

149. NASA Video Teleconferencing System

NASA Headquarters (Code TS)

Description of the Activity:

The NASA Video Teleconferencing System is a state-of-the-art audio and video conference system that provides full motion, color video conferencing to all NASA installations through the Program Support Communications Network. Specially designed conference rooms at each installation can participate in point-to-point or multiparty interactive conferences. Each video conference room is equipped with two 64-inch rear screen video projectors for full motion and graphic images; two video recorders, a facsimile machine, a Video Show graphics system with color printer, and a viewgraph capability. The Program Support Communications Network provides the wideband satellite and terrestrial transmission support for the video conferencing. At present, the network is configured to support two simultaneous video conferences.

Benefits Achieved:

The Video Teleconferencing System contributes to increased agency productivity by enabling agency personnel to meet face-to-face more frequently and on short notice. In some instances, video teleconferencing can serve as a substitute for travel, thereby avoiding travel cost and saving personnel time. Video teleconferencing is also an effective means of managing reduced travel resources. It allows individuals who are unable to travel to a meeting to still actively participate in that meeting.

Contact for more information:

Sandra Bates
202/453-2007

150. Using ViTS to Network NEWMAST/NEWEST Programs

NASA Headquarters (Code XEE)

Description of the Activity:

NASA's Educational Affairs Division conducted two conferences using the Video Teleconferencing System (ViTS) linking the NASA Educational Workshops for Math, Science, and Technology Teachers (NEWMAST) and the NASA Educational Workshop for Elementary School Teachers (NEWEST) participants at six NASA centers with NASA Headquarters and National Science Teachers Association (NSTA) program managers and staff. These conferences were held in June and August 1988.

Benefits Achieved:

These conferences allowed the NASA Headquarters Educational Affairs Director and program managers, and NSTA program director and staff to interface with workshop participants without traveling to each individual center. Workshop participants were able to share highlights of their programs with other NASA centers.

These benefits save travel money; but, they also provide immediate feedback from workshop participants, enabling program managers to make improvements in future workshops.

Contact for more information:

Larry Bilbrough
202/453-8395

V. PRODUCTIVITY MEASUREMENT

151. Classified Storage Containers

Goddard Space Flight Center (GSFC)

Description of the Activity:

GSFC has a continuing requirement for classified storage containers. A no-cost acquisition of safes was made to meet GSFC needs.

Benefits Achieved:

A total of 55 safes were transferred from Andrews Air Force Base at no cost (a savings of \$49,000). Andrews also provided transportation. This will help GSFC to meet the requirement to phase out lightweight containers for storage of classified information by 1990.

Contact for more information:

Pat Mackey
301/286-7233

152. Performance Measurement System

Johnson Space Center (JSC)

Description of the Activity:

The Performance Measurement System (PMS), implemented by the Orbiter and Government Furnished Equipment (GFE) Projects Control Office, provides an objective measurement of how the contractor is performing a contract from the standpoint of cost and schedule. The monthly PMS reports assist with identifying costs and schedule trends, and indicate the magnitude of potential problems. The budget analyst can use PMS to identify problems promptly, before an overcost or overrun in scheduling becomes difficult to manage. This system also enables the analyst to more effectively identify the cause of contract problems, and propose more informed budget solutions.

Benefits Achieved:

The PMS allows the analyst to actively manage a given program against a baseline measurement. Benefits of the PMS includes confidence in contractor's internal management system, objective contract status monitoring, identification of problems not previously recognized, capability to trace problems to the source, quantitative measure of schedule deviation in dollars, and performance measurement against a contract baseline.

Contact for more information:

J. Greg Smith
713/483-1427

153. Productivity Measurements for SR&QA Surveys/Audits

Kennedy Space Center (KSC)

Description of the Activity:

The KSC Plans, Policy and Compliance Office, RQ-POL, has established and instituted several measurement indicators to trend and evaluate the effectiveness of surveys and audits conducted on KSC's Safety, Reliability, and Quality Assurance (SR&QA) and Configuration Management Programs. The charts, graphs, and statistical data pertain to the number of surveys/audits performed per fiscal year, time it takes to close surveys and audits, total items identified each fiscal year on audits/surveys, number of items documented in surveys by each survey team member, number of audits conducted and percent of deficiencies identified by each auditor, and a listing of organizations audited/surveyed to assure uniformity and mix of organizations at KSC. This information is periodically issued to office personnel.

Benefits Achieved:

By using quantitative data, the "casual observation" approach by supervision to measure productivity and efficiency has been replaced by a precise, structured process. This system has been invaluable during the rating of nonsupervisory employees during their performance appraisals.

Contact for more information:

Bruce L. Jansen
407/867-3481

154. Research Assessment System

Lewis Research Center (LeRC)

Description of the Activity:

The Materials Division at Lewis has developed and implemented a system to qualitatively measure research publications. After piloting the system in one branch to validate the system and establish inter-rater reliability, it is now being used in the other branches of the division as well.

The system focuses on a number of critical elements for research publications, which are grouped under three major headings: quality of research, quality of writing, and scope and impact. These are evaluated and scored by at least two raters. Evaluators are guided by about 40 questions and criteria, ranging from relevance and adequacy of the literature survey to whether or not the results provided a new insight, concept, interpretation, or model.

Benefits Achieved:

Evaluation results are discussed with the author, the Branch Chief, and the Division Office; and are used to focus on improving the quality of the Division's research. The measurement and subsequent discussions can lead to upfront guidance as well as after-the-fact assessment. Aggregate assessment scores also highlight areas for organizational quality improvement.

Contact for more information:

Carl Lowell
216/433-3191

155. Work Group Performance Objective Matrix

Stennis Space Center (SSC)

Description of the Activity:

The Performance Objective Matrix (POM), a group performance measurement system applicable to most employees at Pan Am/FOS, tracks a work group through the establishment of 4 to 8 criteria, and attendant weights and baselines. The criteria or objectives are determined by the work group in cooperation with SSC management, thus maintaining the spirit and intent of participative management. The work group controls the data, measures its own monthly performance, and uses group problem-solving to address trends that indicate declining performance. Rewards are given for sustained performance at double and triple the original group baselines. The leading work group at the end of each month is awarded a plaque with the team name engraved under the month in which they won. Each time a team receives the award, photographs are taken and displayed on bulletin boards; and that team's accomplishments are disseminated to the internal SSC and local media. The team that wins the plaque the most months during the year retains the plaque for permanent display.

The number of Performance Teams using the matrix system to measure their performance has increased to 17 since its introduction in 1986. During 1988, nearly \$25,000 was awarded to these teams for performing at double or triple their established baselines.

Benefits Achieved:

This matrix provides a clear, simple, and cost-efficient measurement system that allows direct comparison of performance between normally disparate work groups. Using a single index of performance per work group enables management to clearly see the leaders who compete for monthly recognition. The increased number of work groups participating in the matrix is an indication that it has become a source of pride and motivation for the groups. Group performance consistently increases and is easily measurable. (To date, no work group has performed below the baselines.)

The Performance Team Leader for 1988 was the Shipping and Receiving Team, which scored 1000 each month - the highest level achievable. The team reset their baseline four times during the year and still maintained performance excellence. In addition to receiving cash bonuses, the team was selected to represent the SSC Quality Circle program at NASA Headquarters' Quality Day.

Contact for more information:

Dr. Marco Giardino (Pan Am World Services)
601/688-1190

VI. CONTRACTORS - CONTRACTOR EFFORT

156. Enhanced Productivity Through Simulation

Ames Research Center (ARC)

Description of the Activity:

Software Engineering support for both software and hardware applications. Specifically, the scope includes: developing space station data network analyses via simulation, development of Artificial Intelligent Simulation Tools, and Machine Learning Analyses.

Benefits Achieved:

Recom Software, Inc., a NASA Minority Federal Contractor, has provided superior scientific support. An example has been the evolution of a data processing network simulation project, called DPNS. Recom recognized that the direction of the agency was towards applying Artificial Intelligence (AI) technology to increase the utility of tools, and as a consequence, productivity. Therefore, Recom recommended and participated in the construction of a friendly, graphic user interface as a platform for AI technology applied to simulation. The interface, which runs on PC-compatible computers and was implemented in the language of Smalltalk, and has attracted much interest within the agency.

Contact for more information:

Donald B. McKellar
415/694-4162

157. Space Flight Assembly Team

Goddard Space Flight Center (GSFC)

Description of the Activity:

IDEAS, Inc., a local contractor, was asked to assemble a team of their most experienced space flight assemblers that would be dedicated and provide quick-reaction responses to the completion of the Cosmic Background Explorer (COBE) Differential Microwave Radiometer (DMR), Diffused Infrared Background Experiment (DIRBE), and Far Infrared Absolute Spectrometer (FIRAS) Instruments.

Benefits Achieved:

This team has met or exceeded every COBE deadline and produced highest quality space flight electronic assemblies. The cooperation and hard work of the team was outstanding. They continually performed last-minute changes and the final buttoning-down of the Instruments in a smooth, rapid and professional manner. The motivation and excellent support of each team member has contributed enormously to the progress and successful completion of the COBE Program.

Contact for more information:

Carl R. Bayne
301/286-7304

158. PIQE Program/Improved Calibration at Cortez III Service Corporation

Lewis Research Center (LeRC)

Description of the Activity:

Cortez III, the consolidated logistics support services contractor at Lewis, has made significant gains in quality and productivity during 1988. Fifty-one of their suggestions were accepted and implemented under the "Bright Idea" program. This accomplishment, along with their participation in Quality Circles and Productivity Action Teams, as well as their Productivity Enhancement Submittals, resulted in a productivity fee that was distributed directly to employees, with an average payout of more than \$450.00.

An example of one productivity enhancement concerned a better method of obtaining and maintaining the triple point temperature of water (where it can be maintained in a liquid, solid or gaseous state). This temperature is used as the benchmark for calibrating platinum resistance thermometers. The new method uses powdered dry ice in a vibrating flask.

Benefits Achieved:

The productivity program at Cortez III provides quality and productivity benefits to the government, and creates a focus on continuous quality and productivity improvement within the company. In the specific case of improved calibration procedures, the new method keeps the ice in contact with the flask where a uniform mantle is formed and maintained. This can maintain the triple point temperature for 1 hour or more. The number of calibrations per hour has approximately doubled; accuracy is enhanced and process safety improved.

Contact for more information:

Eugene Elleman (Cortez III Service Corporation)
216/433-8055

159. PSCN Productivity Improvements

Marshall Space Flight Center (MSFC)

Description of the Activity:

The PSCN management reviewed and analyzed program costs, and determined that significant savings could be realized by negotiating with American Telephone and Telegraph (AT&T) for a Volume Pricing Plan (VPP).

Benefits Achieved:

As a result of this initiative, Program Support Communications Network (PSCN) costs have been reduced by over \$1 million annually. By committing the PSCN to \$200,000 per month minimum billing through 1990, T-1 circuit costs were reduced from \$15.50 to \$11.50 per mile; and AT&T's per circuit charges were reduced from \$2,600 to \$2,100 per month. Additional savings will be realized in 1989 by VPP tariff changes, reducing the cost per mile to \$9.72, and the per circuit cost to \$1,458 per month.

Contact for more information:

Guy Davis (Boeing Network Services)
205/544-6753

160. Setting AC Gain - Dynamics Universal Signal Conditioner

Stennis Space Center (SSC)

Description of the Activity:

During the calibration process, a variable trimmer capacitor (7-25 pf) is installed in place of the selectable capacitor. By using this method, the gain of the unit can be adjusted exactly.

Benefits Achieved:

This process avoids the expense of buying and stocking large quantities of different fixed-size capacitors, as well as the time formerly needed for the technician to select and install the different size capacitors until the correct size could be determined.

Contact for more information:

George B. Nelson (Svedrup Technology, Inc.)
601/688-1336

VII. CONTRACTORS - JOINT EFFORT

161. GSFC/Industry Conference and GSFC Contractor Council

Goddard Space Flight Center (GSFC)

Description of the Activity:

A conference was held at Goddard Space Flight Center (GSFC) in April 1988 to examine and improve the working relationship between the civil servant and contractor communities, whose joint efforts are essential to the successful accomplishment of the NASA/GSFC mission.

The conference resulted in numerous recommendations from the participants, such as the need for continued feedback and a permanent mechanism to facilitate this type of interaction between contractors and civil servants. As a result, working groups of civil servants and contractors were established to examine such areas as procurement, space allocation, productivity, and training. A GSFC/Contractor Council was established as a permanent mechanism for communication. The Council is composed of the center Director, the Director of Management Operations, and seven contractors who represent all on-site and near-site contractors at the GSFC. The first meeting of the Council was held in November 1988.

Benefits Achieved:

The Council provides a mechanism that encourages two-way communication between the civil service and contractor communities. Council meetings provide a forum for the discussion of suggestions, recommendations, problems, or other information from the contractor community. In addition, contractors can voice their opinion regarding policy and procedures that affect the working and social environment, and the civil service community can explain the rationale for policy and procedures.

Contact for more information:

Carl J. Poleskey
301/286-7830

162. Corrosion Control Certification For NASA and Contractor Engineers/Technicians

Kennedy Space Center (KSC)

Description of the Activity:

In 1988, at the initiative of the KSC Integrated Team (KIT) Corrosion Control Quality Circle, the center established the requirement for coating and inspection certification. The

training is conducted by The National Association of Corrosion Engineers (NACE) at KSC, and covers both NASA and contractor personnel involved in this technical specialty. The training supports an intensive effort at KSC to standardize procedures, minimize duplication of effort, and improve coating inspection techniques.

Benefits Achieved:

Corrosion is a major and continuing concern at the center due to its extensive and costly inventory of NASA flight hardware and ground support. In 1988, for example, over \$2 million for direct corrosion control activities. The NACE program has resulted in professional certification of over 100 NASA and contractor engineers and craftsman during 1988. The NACE training program will continue to facilitate corrosion control efforts at KSC.

Contact for more information:

Jim Norman
407/867-2737

163. Employee Involvement Workshop

Langley Research Center (LaRC)

Description of the Activity:

In September 1988, Martin Marietta provided two of their trainers to offer a 3-1/2 hour workshop on employee involvement teams. Both Langley and contractor employees and supervisors attended. Martin Marietta won the first NASA Excellence Award for contractors and their use of System Refinement Teams was a major influence in their overall success.

Benefits Achieved:

Hearing first-hand of the benefits achieved by Martin Marietta in this area as well as efforts by other NASA centers was informative and instructive. As a direct result of this training, four new employee involvement teams were initiated locally.

Contact for more information:

Clarence M. Cole
804/864-4557

164. Joint Efforts in Publications

NASA Headquarters (Code XEP)

Description of the Activity:

Through a cooperative working relationship between NASA Headquarters (Code XEP) and the Smithsonian Institute, significant cost savings were achieved in the production of the following publications:

"On the Wings of a Dream"
"Space Explorers"
"Discovery" (Packet)

In addition, a cooperative effort with Globe Press provided additional cost savings on the publication entitled "Lift-Off."

NASA provided technical expertise and negotiated split-runs in return for production savings.

Benefits Achieved:

This cooperative effort resulted in savings of over \$360,000.

Contact for more information:

Howard S. Golden
202-453-8327

VIII. CONTRACTORS - CONTRACT ADMINISTRATION

165. Combined Orders for AKMs

Goddard Space Flight Center (GSFC)

Description of the Activity:

The Metsat Project was advised by the USAF Defense Meteorological Satellite Program (DMSP) of their need for an Apogee Kick Motor (AKM) identical to the ones being procured for the National Oceanic and Atmospheric Administration (NOAA)- K, L, M spacecrafts. The contractor advised GSFC of the potential for significant savings if the additional AKM needed for the DMSP could be combined with the three AKM's needed for the NOAA-K, L, and M spacecrafts.

Benefits Achieved:

The U.S. Government benefits from combining the order for the needed AKMs. The Metsat Procurement Office, together with the Metsat Technical Management Office, obtained the necessary transfer of funds from the USAF and included their AKM to be delivered with the three needed for the NOAA-K, L, and M spacecrafts. This action resulted in an estimated savings to the government of approximately \$1,447,000 (\$805,000 for NOAA and \$642,000 for DMSP).

Contact for more information:

Alton D. Payne
301-286-7170

166. Streamlined Contract Management of EMU Program

Johnson Space Center (JSC)

Description of the Activity:

The contractor on the Extravehicular Mobility Unit (EMU) program proposes many configuration changes and submits these proposed changes for NASA approval as Configuration Control Board Directives (CCBDs). These proposed changes are then circulated through a lengthy JSC review cycle and the support contractor community. Constant tracking of the location and disposition of changes is necessary. Previously, the contractor and interim NASA reviewing offices often assigned changes a variety of identification (ID) numbers, making changes extremely difficult to track and status.

This procedure has been improved by assigning the contractor a block of formal CCBD numbers for exclusive use of the EMU Program, which the contractor assigns to proposed

changes. The CCBD number is now the sole identifier of a proposed change through the entire NASA review and approval system. In addition to more succinct identification procedures, the EMU contract "changes threshold" was increased from \$100,000 to \$400,000.

Benefits Achieved:

The improved configuration change numbering system has resulted in a substantial savings of government and contractor time. Proposed changes must be tracked for status and scheduling purposes at least three times during the review cycle. Using the old system to identify and locate a proposed change required an average of three times, taking approximately 2 man-hours. In a typical 6-month period, the contractor submitted over 40 proposed changes, which equated to over 240 man-hours.

Under the new numbering system, tracking a change by its sole identifying number takes virtually no time; so the direct savings of this system over a 6-month period would be well over 240 man-hours in time and several thousand dollars in direct labor costs per change. In addition, by increasing the changes threshold the potential savings of direct and indirect costs can amount to between \$2,500 and \$5,000 per proposal change. Both of these changes have demonstrated much-needed capabilities for improving scheduling and expediting program changes, serving as a model for other areas of contract management.

Contact for more information:

Ruth M. Elder
713/483-2141

167. Copier Supplier Contract Consolidation

Langley Research Center (LaRC)

Description of the Activity:

Langley consolidated its copier supplier contract. Multiple suppliers meant multiple maintenance contracts, different supplies to order for upkeep and usage, and varying degrees of customer service, among other factors. Costs to perform maintenance, obtain supplies, and replace older models averaged \$434,000 a year for the last 4 years.

Benefits Achieved:

The 131 new copiers were obtained from a single supplier; 2 dedicated on-site technicians were added for troubleshooting/maintenance; and 42 line items of stock needed in previous years were deleted. The estimated savings over the next 2 years is \$150,000. The net gain from selling the old copiers should finance at least 1 year's total cost of doing business under the single supplier arrangement.

Contact for more information:

Ronald R. Krodel
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168. ACTS Contract Restructuring

Lewis Research Center (LeRC)

Description of the Activity:

Responding to Congressional direction to "cap" the program costs, the Lewis Advanced Communication Technology Satellite (ACTS) Project Office, GE, COMSAT and NASA successfully restructured the entire program. A review of all phases of this research and development program was made in an effort to reduce costs, while maintaining the advanced technology development initiatives originally established for ACTS.

The principal aspects of this endeavor included: (1) major changes to the contractual arrangement with the termination of one subcontractor whose effort was absorbed by the prime, and the shift of the second subcontractor to an associate contractor role; (2) NASA's decision to assume a proactive management role in managing the newly formed dual contractor arrangement; (3) elimination of program "niceties" while retaining all technology goals; and (4) resolution of the remaining performance specifications.

Benefits Achieved:

The results of this restructuring effort enabled NASA to respond to Congressional direction to cap the ACTS Program at a reduced level, while maintaining a viable program. The contractors accepted caps as well, which emphasized a commitment by their management to control costs. Aggregate cost savings achieved were in excess of \$30 million. Great strides were made in 1988 to stabilize the program, assuring the technological advancements promised by ACTS will be available in the 1990's.

Contact for more information:

Thomas St. Onge
216/433-3557

169. Commercial Launch Services for NASA Missions

Lewis Research Center (LeRC)

Description of the Activity:

Lewis developed an approach for procurement of commercial launch services for government missions that is consistent with the administration's commercialization of space policy while ensuring that the nation's interests are protected. This approach has been used by Lewis for procurement of Atlas/Centaur Launch Services for NOAA on the GOES Missions, and has become a pathfinder and model for other vehicle classes being used by other NASA centers.

Benefits Achieved:

This approach (the first of its kind) has served as a model for other procurements and other vehicle classes. Government costs are reduced because of NASA's ability to take advantage of larger block buys by the contractor. With commercial launch services, NASA manpower requirements are reduced for engineering and oversight. Finally, this new approach provides for responsible commercialization of space while ensuring that the government's requirements are being met.

Contact for more information:

Ed Muckley
216/433-6183

170. MSFC Procurement Process Improvement

Marshall Space Flight Center (MSFC)

Description of the Activity:

The Procurement Office has developed and implemented an automated program that provides for electronic scanning input of synopses to the Commerce Business Daily (CBD). The program was implemented in April 1988 and is used by procurement personnel. The Procurement Office also gets advanced electronic notification 24 hours before publication of synopses.

Benefits Achieved:

This program cuts a minimum of 7 days lead-time from procurement actions that require publication in the CBD.

Contact for more information:

Charles Henke
205/544-0253

171. Automated Clearing House (ACH) Vendor Payment System

Marshall Space Flight Center (MSFC)

Description of the Activity:

An Electronic Funds Transfer payment system was designed by the Treasury's Financial Management Service using the ACH System, which is a batch processing system that is especially suited for large volumes of activity.

Benefits Achieved:

Approximately 80 percent of all MSFC vendor payments are now made through this system, resulting in significant savings in time and labor.

Contact for more information:

H. William Hallisey
205/544-0092

172. Automated Procurement Regulation Subsystem (PRS)

Marshall Space Flight Center (MSFC)

Description of the Activity:

An automated program has been developed that allows Procurement Office personnel fast access to the Federal Acquisition Regulations (FAR), the NASA FAR Supplement, and the Federal Information Resources Management Regulation (FIRMR). This program will aid in the preparation of most procurement actions, and also can be used as a learning tool for preparing those documents.

Benefits Achieved:

The program facilitates most procurement actions. It also saves money and office space by making the previously used, voluminous and expensive hard copies unnecessary.

Contact for more information:

Charles Henke
205/544-0253

173. Consolidation of Support Contracts

NASA Headquarters (Code EM)

Description of the Activity:

By 1987, the Flight Systems Division had four different contractors providing support to the Space Station Utilization activity. In 1988, EM proposed to consolidate all support activity for Space Station under one task-order contract, covering both technical and administrative activities. This was accomplished and a single contractor was selected in mid-1988.

Benefits Achieved:

The contractor is able to maximize full utilization of human resources; this has resulted in a lower level of manpower than would have been required with multiple specialized contracts and this has been accomplished with no compromise of performance. There are approximately 15 FTE on this support activity. Previous support from multiple sources totalled about 20, and there was not as high a level of performance. In addition, less civil service manpower is required to administer one contract, instead of three. The estimated savings is approximately 5 percent for one Civil Service FTE with the present arrangement.

Contact for more information:

Paula Burnett Frankel
202/453-3971

174. Property Custodian Program

NASA Headquarters (Code NIE)

Description of the Activity:

After successful field testing of the consolidation and contracting-out of property custodian duties at the Lewis Research Center, Code NIE revised agency equipment management policy in 1988 to enable all installations to consolidate and contract-out property custodian duties.

Benefits Achieved:

As demonstrated by Lewis, the contractor/NASA installation joint initiative not only yielded improved equipment control and management, but relieved 150 scientists/engineers, researchers and technicians of substantial administrative duties while furthering the government's contracting-out initiative. Lewis estimated a net savings of 3.2 man-years at that center alone.

Contact for more information:

Jeff Sutton
202/453-2973

175. Associate Contractor Agreements

NASA Headquarters (Code S)

Description of the Activity:

Hardware for Space Station Freedom will be built and assembled in increments by four major contractors and hundreds of subcontractors. To streamline the process of definition, management, and implementation of contractor-to-contractor delivery of hardware, the Space Station Freedom Program Office (SSFPO) instituted Associate Contractor Agreements between the work package contractors.

Benefits Achieved:

Because contractors and subcontractors will interface directly (rather than through NASA centers) to resolve scheduling and interface issues on intersite deliverables, NASA management time and resources will be freed to respond only to those issues that require rebalancing of resources. This process will streamline issue resolution, and avoid costly paperwork and delays.

Contact for more information:

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ACKNOWLEDGMENTS

Many individuals deserve recognition for their contributions to this sixth annual Accomplishments Report: **John L. Reiss**, Staff Assistant, Administration, Ames Research Center; **Gene Guerny**, Special Programs Officer, Goddard Space Flight Center; **Charles E. Herberger**, Manager, Quality and Productivity Improvement Programs, Jet Propulsion Laboratory; **Leslie J. Sullivan**, Chief, Management Analysis Office, Johnson Space Center; **Warren L. Camp**, Director, Productivity Applications Staff, Kennedy Space Center; **William L. Williams**, Senior Staff Scientist, George Washington University; **David J. Steigman**, Productivity Program Manager, Lewis Research Center; **William R. Reynolds**, Director, Productivity Improvement Office, Marshall Space Flight Center; **Larry E. Lechner**, Quality and Productivity Specialist, Productivity Improvement Office, Marshall Space Flight Center; **Ronnie E. Carter**, Chief, Reimbursable Funds, Stennis Space Center.

A special note of appreciation is extended to **Sharon Thomas**, Technical Writer, Vitro Corporation, for editing the manuscript and preparing the camera-ready copy.

The staff of the NASA Quality and Productivity Improvement Programs Office made valuable contributions to this report, especially **Geoffrey B. Templeton**, Managing Editor; **Lynne M. Stewart**, Editor; and **Daniel Wu**, Accomplishments Report Data Base Programmer.

Joyce R. Jarrett, Director
NASA Quality and Productivity
Improvement Programs